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VOL. XXI JANUARY, 1932 NO. 1

DELECTUS SEMINUM

BROOKLYN

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List of Seeds Offered in Exchange

These seeds, collected during 1931, are offered to botanic gardens and to other regular correspondents; also, in limited quantities, to members of the Brooklyn Botanic Garden. They are not offered for sale.

An asterisk (*) indicates seeds collected from wild plants.

Applications for seeds must be received **not later than February 28, 1932.**

DICOTYLEDONES

Acanthaceae 266

Acanthus
longifolius Poir.
mollis L.

Aizoaceae 84

Mesembryanthemum
cordifolium L.

Amarantaceae 79

Alternanthera
spinosa L.
Amarantus
atropurpureus Hort.
Celosia
plumosa Hort.
Gomphrena
globosa L.
Telanthera
polygonoides Moq.

Araliaceae 227

Aralia
*hispida Vent.
*nudicaulis L.
*racemosa L.

Aristolochiaceae 74

Asarum
*canadense L.

Asclepiadaceae 248

Asclepias
*amplexicaulis Sm.
*incarnata L.
*syriaca L.
*tuberosa L.
Cynanchum
nigrum Pers.
Vincetoxicum Pers.

Balsaminaceae 168

Impatiens
*biflora Walt.
scabrida DC.
Sultani Hook f.

Basellaceae 86

Basella
rubra L. var. alba
Boussingaultia
baselloides HBK.
(tubers)

Berberidaceae 93

Caulophyllum
*thalictroides Michx.

Boraginaceae 252

Anchusa
officinalis L.
Echium
vulgare L.
Myosotis
*laxa Lehm.
Nonnea
rosea (Bieb.) Fisch. & Mey.

Cactaceae 210

Opuntia
*vulgaris Mill.

Campanulaceae 276

Campanula
bononiensis L.
carpatica Jacq. var. alba
cenisia L.
latifolia L. var. eriocarpa DC.
latifolia L. var. macrantha Sims
Jasione
montana L.
Platycodon
grandiflorum DC.
Specularia
*perfoliata (L.) A.DC.

Capparidaceae 107

Cleome
graveolens Raf.
graveolens var. macrantha Turcz.
graveolens var. spinosa
graveolens var. violacea
Polanisia
trachysperma T. & G.

Caryophyllaceae 87

Arenaria
*caroliniana Walt.
liniflora L.
stricta Michx.
Cerastium
*arvense L.
Biebersteinii DC.
Thomasi Ten.
Dianthus
alpinus L.
caesius Smith var. grandiflorus
liburnicus Bartl. & Wendl.
superbus L. var. speciosus
"Sweet Wivelsfield"
tymphresteus Heldr. & Sart.
Gypsophila
fratensis Hort.
perfoliata L.
repens L. var. monstrosa
Lychnis
alba Mill.
Coronaria Desr.
Flos-Jovis Desr.
fulgens Fisch.
Silene
acaulis L.

alpestris Jacq.
Armeria L.
latifolia Brit. & Rendle
maritima With.
Zawadskii Herbich
Spergularia
rubra Presl
Tunica
prolifera (L.) Scop.
Saxifraga Scop.
Viscaria
vulgaris Roehl.
vulgaris var. splendens

Chenopodiaceae 78

Atriplex
*patula L. var. hastata (L.) Gray
Chenopodium
Bonus-Henricus L.
virgatum Thunb.

Cistaceae 193

Helianthemum
*canadense Michx.
violaceum Lange
Hudsonia
*ericoides L.

Compositae 280

Anaphalis
*margaritacea Benth. & Hook.
Antennaria
*plantaginifolia Rich.
Anthemis
tinctoria L.
Arnica
foliosa Nutt.
longifolia Eaton
Artemisia
Purshiana Bess.
vulgaris L.
Aster
alpinus L.
Amellus L.
Amellus var. "King George"
Amellus var. "Mauve Cushion"
*cordifolius L.
*divaricatus L.
*ericoides L.
Farreri Smith & Jeffrey
*laevis L.
subcaeruleus S. Moore
*tenuifolius L.
Bidens
*comosa (Gray) Wiegand
grandiflora Balb.
Buphthalmum
speciosum Schreb.
Cacalia
suaveolens L.
Calendula
fulgida Raf.
stellata Cav.
Centaurea
Jacea L.
Scabiosa L.
Chrysanthemum
cinerariaefolium (Trev.) Vis.
Parthenium (L.) Bernh.
Chrysopsis
*falcata (Pursh) Ell.
Cichorium
Intybus L.
Cnicus
Benedictus L.
Coreopsis
grandiflora Hogg
lanceolata L.
palmata Nutt.
verticillata L.
Cousinia
Hystrix C. A. Mey.
Dimorphotheca
pluvialis (L.) Moench
Echinops
sphaerocephalus L.

Erechtites
*hieracifolia (L.) Raf.
Erigeron
corymbosus Nutt.
speciosus DC.
Eupatorium
coelestinum L.
*hyssopifolium L.
*pubescens Muhl.
*purpureum L.
*maculatum L.
*trifoliatum L.
*urticaefolium Reichard
*verbenaefolium Michx.
Gaillardia
pulchella Fouq.
Helenium
"Riverton Beauty"
"Riverton Gem"
tenuifolium Nutt.
Helianthus
angustifolius L.
annuus L.
Maximiliani Schrad.
orgyalis DC.
Helichrysum
bracteatum (Vent.) Willd.
Heliopsis
helianthoides (L.) Sweet
Hieracium
speciosum (Willd.) Hornem.
*venosum L.
Inula
squarrosa L.
Krigia
*amplexicaulis Nutt.
Leontopodium
alpinum Cass.
Melampodium
perfoliatum HBK.
Mikania
*scandens (L.) Willd.
Picridium
vulgare Desf.
Pluchea
*camphorata (L.) DC.
Rudbeckia
maxima Nutt.
occidentalis Nutt.
speciosa Wend.
subtomentosa Pursh
Senecio
*aureus L.
Clivorum Maxim.
macrophyllus Bieb.
orientalis Willd.
Silphium
laciniatum L.
perfoliatum L.
Solidago
*altissima L.
*caesia L.
Cutleri Fernald
*juncea Ait.
*macrophylla Pursh
*nemoralis Ait.
*puberula Nutt.
*rugosa Mill.
*sempervirens L.
*tenuifolia Pursh
Stokesia
laevis Hill
laevis var. alba
Vernonia
*noveboracensis Willd.
Zinnia
multiflora L.
verticillata Andr.

Cornaceae 229

Cornus
*canadensis L.

Crassulaceae 115

Sedum
album L.
Ellacombianum Praeger
elongatum Wall.
Fabaria Koch

Cruciferae 105

Alyssum
dasycarpum Steph.
saxatile L.
Arabis
*laevigata (Muhl.) Poir.
*lyrata L.
Berteroa
incana (L.) DC.
Cakile
*edentula (Bigel.) Hook.
Erysimum
asperum DC. var. perenne
pachycarpum Hook. & Thom.
Iberis
amara L.

Cucurbitaceae 275

Echinocystis
lobata (Michx.) Torr. & Gray

Datiscaceae 207

Datisca
cannabina L.

Dipsacaceae 274

Cephalaria
ambrosioides R. & S.
graeca R. & S.
Dipsacus
fullonum L.
Scabiosa
amoena Jacq.
caucasica Bieb.

Droseraceae 112

Drosera
*longifolia L.

Ericaceae 233

Chimaphila
*umbellata (L.) DC.

Euphorbiaceae 147

Euphorbia
marginata Pursh
*polygonifolia L.

Fumariaceae 104a

Corydalis
*sempervirens (L.) Pers.

Gentianaceae 246

Gentiana
*Andrewsii Griseb.
Nymphoides
peltatum (Gmel.) Britt. & Rendle

Geraniaceae 129

Geranium
*maculatum L.
pratense L.

Hypericaceae 187

Ascyrum
*stans Michx.
Hypericum
*gentianoides (L.) BSP.
*mutilum L.

Labiatae 254

Collinsonia
*canadensis L.
Elsholtzia
cristata Willd.
Galeopsis
Tetrahit L.
Hedeoma
*pulegioides (L.) Pers.
Hyssopus
officinalis L.
Leonurus
Cardiaca L.
Marrubium
Kotschyi Boiss. & Hohen.
vulgare L.

Monarda
didyma L. var. rosea
fistulosa L.
mollis L.
Phlomis
alpina Pall.
tuberosa L.
Salvia
acetabulosa L.
jurissicii Kosan.
pratensis L. var. Baumgartenii
Sclarea L.
splendens Ker-Gawl.
virgata Ait.
Satureia
hortensis L.
montana L.
vulgaris (L.) Fritsch
Scutellaria
canescens Nutt.
peregrina L.
Stachys
grandiflora Benth.
*hyssopifolia Michx.
officinalis (L.) Trevisan
Trichostema
*dichotomum L.

Leguminosae 128

Amphicarpa
*monoica ((L.) Ell.
Apios
*tuberosa Moench
Baptisia
*tinctoria (L.) R. Br.
Cassia
*Chamaecrista L.
*nictitans L.
Crotalaria
*sagittalis L.
Cytisus
multiflorus Sweet
nigricans L.
praecox Bean
Desmodium
*canadense (L.) DC.
*Dillenii Darl.
Genista
dalmatica Bartl.
pilosa L.
radiata Scop.
sagittalis L.
Lathyrus
vernus Bernh.
Lespedeza
*angustifolia (Pursh) Ell.
*capitata Michx.
*violacea (L.) Pers.
Trifolium
alpestre L.

Linaceae 132

Linum
africanum L.
narbonense L.
perenne L.
usitatissimum L.

Lobeliaceae 276a

Lobelia
*cardinalis L.
*inflata L.

Lythraceae 216

Cuphea
lanceolata Ait.
procumbens Cav.
Lythrum
Salicaria L.
Salicaria var. roseum

Malvaceae 175

Anoda
hastata Cav.
Hibiscus
militaris Cav.
Moscheutos L.
Moscheutos Hybrids
trionum L.

Kitaibelia
vitifolia Willd.
Sidalcea
candida A. Gray
neo-mexicana A. Gray

Melastomaceae 223

Rhexia
*virginica L.

Nyctaginaceae 80

Mirabilis
Jalapa L. (red)

Onagraceae 224

Epilobium
*angustifolium L.
*coloratum Muhl.
hirsutum L.
Oenothera
biennis L.
Drummondii Hook.
fruticosa L.
speciosa Nutt.

Papaveraceae 104

Argemone
Barclayana Penny
Glaucium
flavum Crantz
Papaver
alpinum L.
Heldreichii Boiss.
lateritium C. Koch
nudicaule L.
orientale L.
Sanguinaria
*canadensis L.

Phytolaccaceae 83

Phytolacca
*decandra L.

Plumbaginaceae 238

Acantholimon
glumaceum Boiss.
Armeria
pungens Hoffm. & Link
vulgaris Willd.
vulgaris var. Laucheana Voss.
Welwitschii Boiss.
Statice
incana L.

Polemoniaceae 250

Gilia
aggregata (Pursh) Spreng.
capitata Dougl.
tricolor Benth.
Polemonium
reptans L.

Polygonaceae 77

Antigonon
leptopus Hook. & Arn.
Eriogonum
umbellatum Torr.
Polygonella
*articulata (L.) Meisn.
Polygonum
Aubertii Henry
Baldschuanicum Regel.
cuspidatum Sieb. & Zucc.
*virginianum L.

Portulacaceae 85

Calandrinia
grandiflora Lindl.
Portulaca
grandiflora Hook.
marginata HBK.
Talinum
patens Willd.

Primulaceae 237

Anagallis
arvensis L.
Lysimachia
punctata L.

*quadrifolia L.
*terrestris (L.) BSP.
Trientalis
*americana (Pers.) Pursh

Pyrolaceae 231

Monotropa
*Hypopitys L.

Ranunculaceae 91

Aconitum
Fischeri Reichb.
Actaea
*alba (L.) Mill.
*rubra (Ait.) Willd.
Anemone
baldensis L.
parviflora Michx.
Pulsatilla L. var. alba
sibirica L.
sylvestris L.
Anemonella
*thalictroides (L.) Spach
Aquilegia
*canadensis L.
chrysantha Gray var. alba
chrysantha var. nana
vulgaris L.
Cimicifuga
dahurica Maxim.
racemosa (L.) Nutt.
Clematis
integrifolia L.
Jouiniana Schneid. var. Campanile
*ochroleuca Ait.
Coptis
*groenlandica (Oeder) Fernald (C. trifolia of auth.)
Delphinium
grandiflorum L.
grandiflorum var. album Maackianum Hort.
tatsienense Franch.
Paeonia
corallina Retz.
Ranunculus
*allegheniensis Britton
*septentrionalis Poir.
Thalictrum
*dioicum L.
*polygamum Muhl.
squarrosum Stephan.
Trollius
asiaticus L.
chinensis Bunge
europaeus L.

Resedaceae 108

Reseda
alba L.
lutea L.
odorata L. var. grandiflora "Sutton's Giant"

Rosaceae 126

Agrimonia
*gryposepala Wallr.
odorata Mill.
Geum
*rivale L.
urbanum L.
Gillenia
*trifoliata (L.) Moench
Potentilla
atrosanguinea Wall.
chrysantha Trev.
grandiflora L.
"Miss Wilmott"
Nuttallii Lehm.
recta L.
recta var. sulphurea
rupestris L.
viscosa Donn.

Rubiaceae 270

Houstonia
*caerulea L.

Mitchella
*repens L.

Rutaceae 137

Dictamnus
albus L.
albus var. rubra

Sarraceniaceae 110

Sarracenia
*purpurea L. "floribus flavis"

Saxifragaceae 117

Heuchera
*americana L.
hispida Pursh
Mitella
*diphylla L.
Tiarella
*cordifolia L.

Scrophulariaceae 257

Antirrhinum
majus L.
Digitalis
ambigua Murr.
viridiflora Lindl.
Erinus
alpinus L. var. albus
Gerardia
*paupercula (Gray) Britton
Gratiola
officinalis L.
Linaria
*canadensis (L.) Dumont
Pedicularis
*canadensis L.
Pentstemon
barbatus Nutt.
barbatus var. Torreyi Gray
glaber Pursh
glaber var. roseus
hirsutus Willd. var. pygmaea
Menziesii Hook.
ovatus Dougl.
Scrophularia
*leporella Bicknell
marilandica L.
nodosa L.
Verbascum
Blattaria L.
Veronica
spicata L. var. rosea
Teucrium L.
Teucrium var. prostrata
*virginica L.

Solanaceae 256

Atropa
Belladonna L.
Belladonna var. lutescens
Capsicum
annuum L.
annuum var. longum
Datura
Stramonium L.
Nicotiana
alata Link & Otto var. grandiflora
Sanderae Sander
Tabacum L.
Solanum
sisymbriifolium Lam.
Schizanthus
pinnatus Ruiz & Pav.

Umbelliferae 228

Carum
Carvi L.
Chaerophyllum
*canadense Crantz
Cicuta
*maculata L.
Eryngium
coeruleum Bieb.
planum L.

Heracleum
lanatum Michx.
Levisticum
officinale (L.) L. Koch
Myrrhis
odorata Scop.
Oenanthe
pimpinelloides L.
Osmorrhiza
*longistylis (Torr.) DC.
Sanicula
*gregaria Bicknell
Silaus
pratensis Bess.
Sium
*cicutaefolium Schrank
Trinia
vulgaris DC.

Valerianaceae 273

Centranthus
ruber DC.

Verbenaceae 253

Verbena
canadensis (L.) Britton

Violaceae 198

Viola
*fimbriatula Sm.
*latiuscula Greene (few)
*primulifolia L.
*sagittata Ait.

Zygophyllaceae 135

Tribulus
terrestris L.

MONOCOTYLEDONES

Alismaceae 315

Lophotocarpus
*spongiosus (Engelm.) J.G.Sm.
Sagittaria
*Engelmanniana J.G.Sm.
*latifolia Willd. forma gracilis

Amaryllidaceae 340

Hypoxis
*hirsuta (L.) Coville

Araceae 323

Arisaema
*triphyllum (L.) Schott
Symplocarpus
*foetidus (L.) Nutt.

Cyperaceae 320

Carex
*crinita Lam. var. gynandra
*longirostris Torr.
*mirabilis Dewey
*squarrosa L.
*stricta Lam.
*varia Muhl.
*virescens Muhl.
Cyperus
*Houghtonii Torr.
Eriophorum
*viridi-carinatum (Engelm.) Fernald
*tenellum Nutt.

Eriocaulaceae 330

Eriocaulon
*decangulare L.

Gramineae 319

Andropogon
*glomeratus (Walt.) BSP.
Eragrostis
*pectinacea (Michx.) Steud.
Leptoloma
*cognatum (Schultes) Chase

Panicum
*latifolium L.
Sorghastrum
*nutans (L.) Nash
Tripsacum
*dactyloides L.

Haemodoraceae 339

Lophiola
*aurea Ker

Iridaceae 344

Iris
Tectorum Maxim.
*versicolor L.
Sisyrinchium
*atlanticum Bicknell

Liliaceae 338

Allium
Schoenoprasum L. var. sibiricum
senescens L.
Clintonia
*borealis (Ait.) Raf.
Hosta
Sieboldiana Engler
Hyacinthus
azureus Baker
Lilium
*superbum L.
Maianthemum
*canadense Desf.
Medeola
*virginiana L.
Muscari
botryoides (L.) Mill.
racemosum (L.) Mill.
Polygonatum
*biflorum (Walt.) Ell.
Smilacina
*racemosa (L.) Desf.
Smilax
*herbacea L.
Streptopus
*amplexifolius (L.) DC. (few)
*roseus Michx.
Trillium
*erectum L.
*undulatum Willd.
Tulipa
dasystemon Regel
Xerophyllum
*asphodeloides (L.) Nutt.

Orchidaceae 350

Corallorrhiza
*maculata Raf.
Cypripedium
*acaule Ait.

Typhaceae 308

Typha
*latifolia L.

Seeds of Trees and Shrubs

GYMNOSPERMAE

Taxaceae

Taxus
*canadensis Marsh.

DICOTYLEDONES

Aquifoliaceae 157

Nemopanthus
*mucronata (L.) Trel.

Asclepiadaceae 248

Periploca
graeca L.

Caprifoliaceae 271

Viburnum
*acerifolium L.

Ericaceae 233

Arctostaphylos
*Uva-ursi Spreng.

Juglandaceae 60

Platycarya
strobilacea Sieb. & Zucc.

Loganiaceae 245

Buddleia
variabilis Hemsl.

Rosaceae 126

Prunus
tomentosa Thunb.
Rosa
*virginiana Mill.

Salicaceae 56

Salix
*tristis Ait.

Seeds Collected in Oregon and Vicinity

by Mrs. N. P. Gale,

Gates Road, Portland, Oregon

Anemone
occidentalis Wats.
Brodiaea
ixioides (Ait. f.) Wats.
Calochortus
Lobbii (Baker) Purdy
Erythronium
giganteum Lindl.
Hendersonii Wats.
mixed vars. of grandiflorum & giganteum
montanum Wats.
parviflorum (Wats.) Gooding
revolutum Smith var. Johnsoni
Gaillardia
aristata Pursh
Lewisia
oppositifolia (Wats.) Rob.
rediviva Pursh
Lilium
columbianum Hanson
columbianum (dwarf)
Humboldtii Roezl. & Leichtl.
occidentale Purdy
pardalinum Kell.
washingtonianum Kell.
Mentzelia
laevicaulis (Dougl.) T. & G.
Mimulus
Lewisii Pursh
Pentstemon
aridis Rydb.
attenuatus Dougl.
azureus Benth.
Barrettae A. Gray
corymbosus Benth.
cratensis

deustus Dougl.
diffusus Dougl.
diffusus (pink form)
euglaucus C.S. English
fruticosus Cardwellii
(Howell) Piper
glaber Pursh
ovatus Dougl.
Rattanii Gray
Richardsonii Dougl.
speciosus Dougl.
Polemonium
carneum Gray
Sidalcea
virgata Howell
Viola
pedata L.
Zygadenus
Fremontii Wats.

Seeds Collected in Tennessee

by Aaron B. Sharp

Arisaema
polymorphum (Buckl.)
Chapm.
Calycanthus
fertilis Walt.
floridus L.
Cassia
Medsgeri Shafer
Gleditsia
triacanthos L.
Gymnocladus
dioica (L.) Koch
Opuntia
Rafinesquii Engelm.
Solanum
carolinense L.
Solidago
glomerata Michx.

Address requests for seeds to

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Brooklyn Botanic Garden,
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GENERAL INFORMATION

MEMBERSHIP.—All persons who are interested in the objects and maintenance of the Brooklyn Botanic Garden are eligible to membership. Members enjoy special privileges. Annual Membership. $10 yearly; Sustaining Membership, $25 yearly; Life Membership, $500. Full information concerning membership may be had by addressing *The Director, Brooklyn Botanic Garden, 1000 Washington Avenue, Brooklyn, N. Y.* Telephone, Prospect 9-6173.

THE BOTANIC GARDEN is open free to the public daily from 8 a.m. until dusk; on Sundays and Holidays open at 10 a.m.

ENTRANCES.—On Flatbush Avenue, near Empire Boulevard (Malbone Street), and near Mt. Prospect Reservoir; on Washington Avenue, south of Eastern Parkway and near Empire Boulevard; on Eastern Parkway, west of the Museum Building.

The street entrance to the Laboratory Building is at 1000 Washington Avenue, opposite Crown Street.

TO ASSIST MEMBERS and others in studying the collections the services of a docent may be obtained. This service is free of charge to *members of the Botanic Garden;* to others there is a charge of 50 cents per person. Arrangements must be made by application to the Curator of Public Instruction at least one week in advance. No parties of less than six adults will be conducted.

TO REACH THE GARDEN take Broadway (B.M.T.) Subway to Prospect Park Station; Interborough Subway to Eastern Parkway-Brooklyn Museum Station; Flatbush Avenue trolley to Empire Boulevard; Franklin Avenue, Lorimer Street, or Tompkins Avenue trolleys to Washington Avenue; St. John's Place trolley to Sterling Place and Washington Avenue; Union Street or Vanderbilt Avenue trolleys to Prospect Park Plaza and Union Street. BY AUTOMOBILE from points on Long Island take Eastern Parkway and turn left at Washington Avenue; from Manhattan, take Manhattan Bridge, follow Flatbush Avenue Extension and Flatbush Avenue to Eastern Parkway, turn left following Parkway to Washington Avenue; then turn right.

PUBLICATIONS

OF THE

BROOKLYN BOTANIC GARDEN

RECORD. Established, January, 1912. An administrative periodical issued quarterly (1912–1928); bimonthly beginning with 1929. Contains, among other things, the *Annual Report* of the director and heads of departments, special reports, announcements of courses of instruction, seed list, guides, miscellaneous papers, and notes concerning Garden progress and events. Free to members of the Garden. To others $1.50 a year. Circulates in 41 countries.

MEMOIRS. Established, July, 1918. Published irregularly. Circulates in 47 countries.

Volume I. *Dedication Papers:* comprising 33 scientific papers presented at the dedication of the laboratory building and plant houses, April 19–21, 1917. 521 pages. Price $3.50, plus postage.

Volume II. The vegetation of Long Island. Part I, The vegetation of Montauk: A study of grassland and forest. By Norman Taylor, June 11, 1923. 108 pages. Price $1.00, plus postage.

Volume III. Vegetation of Mount Desert Island, Maine, and its environment. By Barrington Moore and Norman Taylor, June 10, 1927. 151 pages. Price $1.60.

CONTRIBUTIONS. Established, April 1, 1911. Papers originally published in periodicals, reissued as "separates," without change of paging, and numbered consecutively. This series includes occasional papers, as well as those embodying the results of research. Twenty-five numbers constitute one volume. Price 25 cents each, $5.00 a volume. Circulates in 34 countries.

57. *New physiologic races of oat smuts.* 22 pages. 1930.

58. *A new method of producing and detecting sorghum hybrids.* 12 pages. 1930.

59. *Hybrids of Iris fulva and Iris foliosa.* 10 pages. 1 colored plate. 1931.

60. *The Iris of Japan.* 46 pages. 1931.

LEAFLETS. Established, April 10, 1913. Published weekly or biweekly during April, May, June, September, and October. The purpose of the *Leaflets* is primarily to give announcements concerning flowering and other plant activities to be seen in the Garden near the date of issue, and to give popular, elementary information about plant life for teachers and others. Free to members of the Garden. To others, fifty cents a series. Single numbers 5 cents each. Circulates in 28 countries.

GUIDES to the collections, buildings, and grounds. Price based upon cost of publication. Issued as numbers of the *Record;* see above.

Guide No. 4. The Japanese Garden. Illustrated. Published, July, 1930. Price, 25 cents. Out of print.

Guide No. 5. The Rock Garden. 28 illustrations. Price, 35 cents. By mail, 40 cents.

Guide No. 6. Japanese Potted Trees (*Hachinoki*). 11 illustrations. Price, 35 cents. By mail, 40 cents.

SEED LIST. (*Delectus Seminum*) Established, December, 1914. Since 1925 issued each year in the January number of the RECORD. Circulation includes 160 botanic gardens and institutions located in 40 countries.

AMERICAN JOURNAL OF BOTANY. Established, January, 1914. Published, in coöperation with the BOTANICAL SOCIETY OF AMERICA, monthly, except during August and September. Subscription, $7.00 a year. Circulates in 48 countries.

ECOLOGY. Established, January, 1920. Published quarterly in coöperation with the ECOLOGICAL SOCIETY OF AMERICA. Subscription, $4.00 a year. Circulates in 48 countries.

GENETICS. Established, January, 1916. Bimonthly. Subscription, $6.00 a year. Circulates in 37 countries.

BROOKLYN BOTANIC GARDEN RECORD

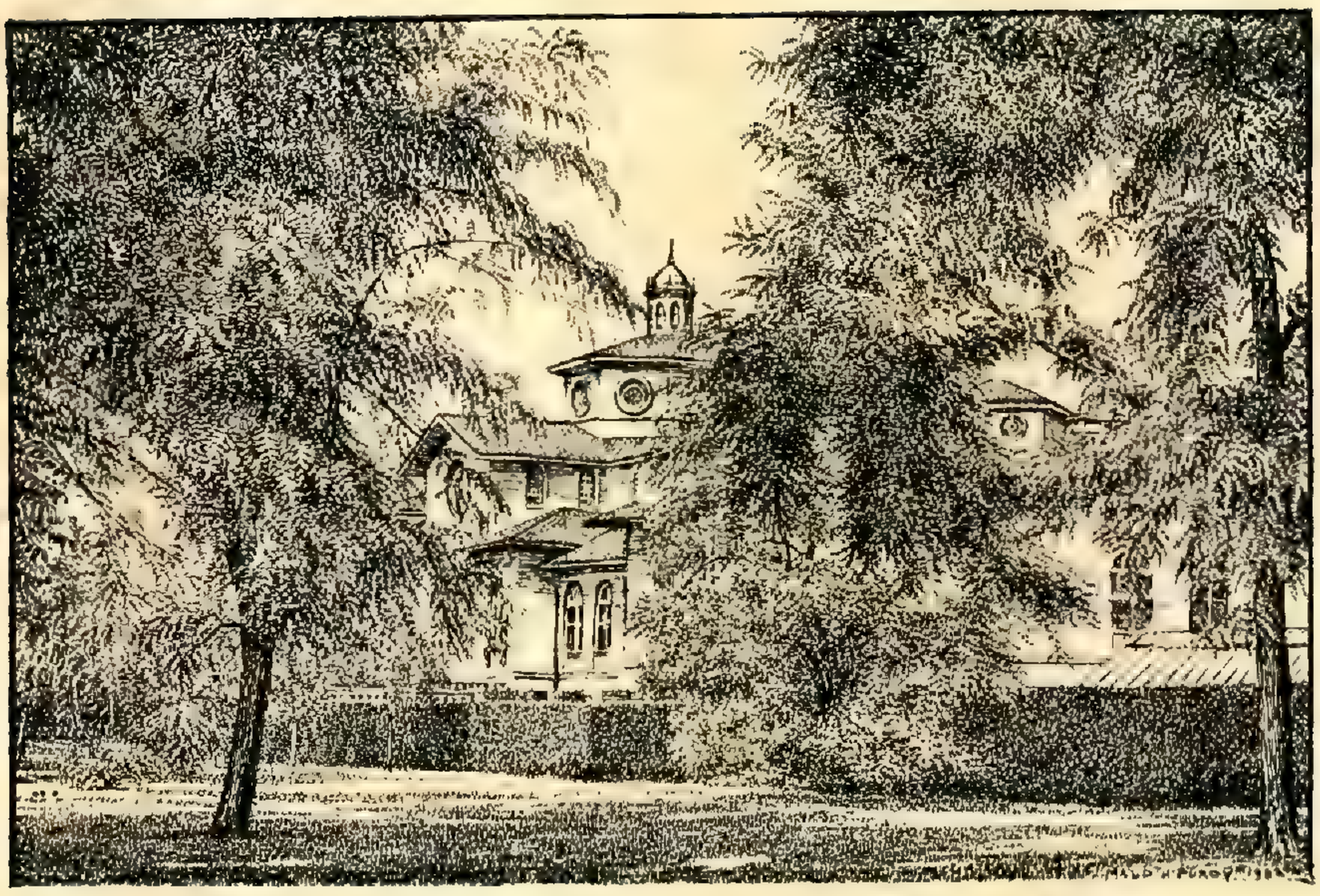
VOL. XXI MARCH, 1932 NO. 2

TWENTY-FIRST ANNUAL REPORT

OF THE

BROOKLYN BOTANIC GARDEN

1931



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BROOKLYN BOTANIC GARDEN

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TWENTY-FIRST ANNUAL REPORT

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BROOKLYN BOTANIC GARDEN

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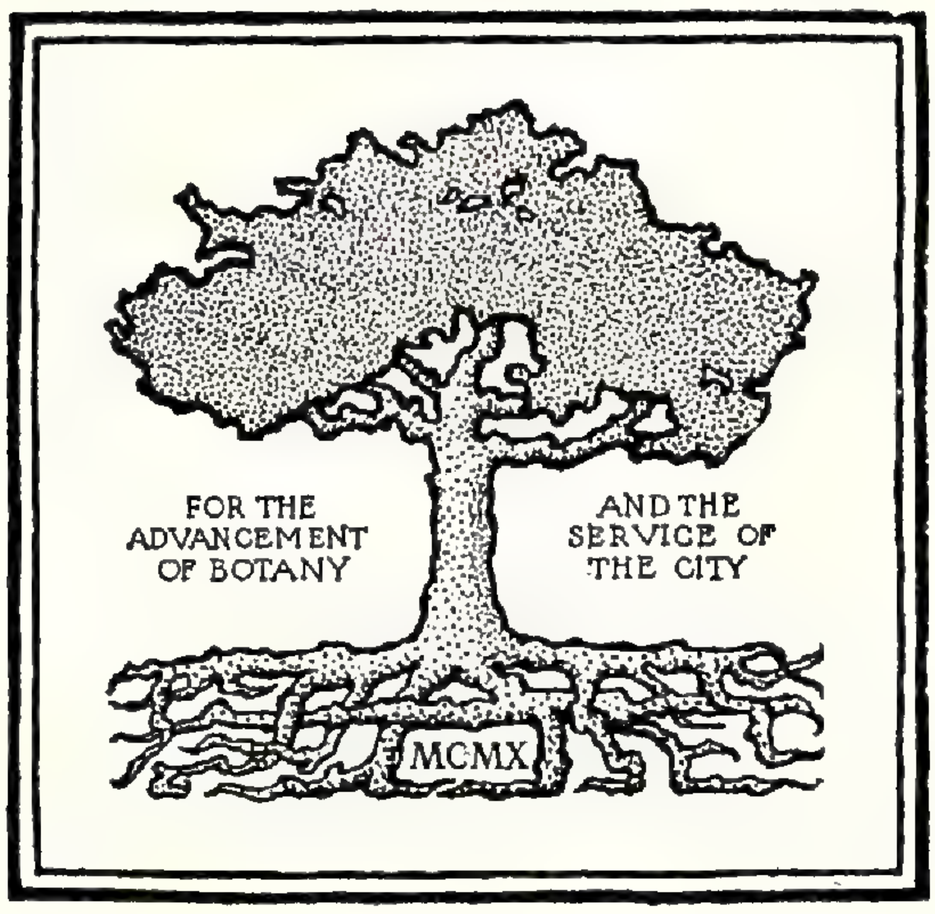

FOR THE ADVANCEMENT AND DIFFUSION
OF A KNOWLEDGE AND LOVE OF PLANTS

BROOKLYN, N. Y.
MARCH, 1932

"A botanic garden and arboretum for the collection and culture of plants, flowers, shrubs, and trees, the advancement of botanical science and knowledge, and the prosecution of original researches therein and in kindred subjects; for affording instruction in the same, and for the prosecution and exhibition of ornamental and decorative horticulture and gardening, and for the entertainment, recreation, and instruction of the people."—*Laws of New York, 1897, Chapter 509. An Act providing for the establishment of a Botanic Garden in the city of Brooklyn.*

FIG. 1. View looking north-east toward the Laboratory Building from the Locusts. (7319.)

TWENTY-FIRST ANNUAL REPORT

OF THE

BROOKLYN BOTANIC GARDEN

1931 [1]

REPORT OF THE DIRECTOR

To the Botanic Garden Governing Committee:

I have the honor to present herewith the twenty-first annual report of the Brooklyn Botanic Garden, covering the activities for the year 1931.

Coming of Age

During the year 1931, the world has experienced the most severe and most widespread economic depression of this generation. Thanks to the practical application of the results of botanical research, combined with favorable weather, the growing season produced bumper crops of wheat and cotton, yet men have gone hungry and insufficiently clad. If economic science, in theory and practice, had been as efficient as biological science our country should (barring the inevitable after-effects of the Great War) have had a year of outstanding prosperity.

On July 1, 1931, the Brooklyn Botanic Garden became of age, so far as its actual activities are concerned. Steps looking toward the establishment of the Garden were taken some years before 1910, but on July 1 of that year the first director, who was also the first member of staff, was appointed, and the work of the Garden was launched. In view of the world condition just noted, it is a pleasure to be able to report that the Garden has made more progress during the year than might reasonably have been expected. As compared with the preceding year, our total attendance has increased by 95,849, our permanent endowment funds by $12,420.16. Our research program has continued, our educational

[1] Brooklyn Botanic Garden Record, Vol. XXI, No. 2, March, 1932.

program has been enriched, and our collections (living plants, herbarium, and library) have increased in size and value, and the public demands upon the Garden have become steadily greater. These and other facts, to be recorded more in detail in the following pages, testify that the Garden is rendering a substantial and much needed service to the local community and to science and education at large. Having completed its period of adolescence the Botanic Garden exercises the right of franchise by casting its first vote in favor of a continued and expanding program of public service through promoting the advancement and diffusion among all the people of a knowledge and love of plant life in every aspect.

Not the least of the distressing effects of a period of economic depression is the fact that organizations and institutions established for the promotion of knowledge, education, and culture are liable to suffer diminished financial support. This may not only involve reduction of staff and other employees (thus adding to the amount of unemployment), but may also cause diminished efficiency and the curtailment of activities which minister to intellectual and spiritual needs. This danger is recognized in a statement recently published by the Charity Organization Society of New York.

"The enemies which must be held at bay this winter are starvation, disease, and *demoralization*. The Charity Organization Society . . . wishes to broadcast far and wide, with emphasis, that the health, recreational, and so-called *character-building organizations* are needed more than ever as our 'second line of defense' this winter. . . . Many givers have felt that they are perhaps 'frills' at a time like this. But they are by no means luxuries. . . . Give—but give to the well organized, responsible, health, recreational, and character-building organizations, those with years of community service to their credit."

We are so accustomed, in this "mechanical age," to evaluate science in terms of its practical applications in commerce, communication, agriculture, et cetera, that we often lose sight of what are its really most important and far-reaching values in emancipating the human mind from superstition and bigotry and wrong methods in the pursuit of knowledge, and in enlarging our mental

horizon and our grasp of the facts and meaning of the universe and of our own existence. A scientific institution, and in particular a botanic garden, does not rise to the full measure of its obligations unless it gives to the generations that support it something more than mere information and profitable recreation. It should, in connection with its educational work, pass on to the public something of the spirit of scientific research, and the immense reach and grasp of scientific problems, processes, and results. In these aspects of its pursuit lies the great, but tardily recognized, value of science as an instrument of character-building—of a liberal, as well as a technical, education.

"Among the values created by the human spirit," said General Smuts, in his presidential address before the British Association for the Advancement of Science last September, "science ranks with art and religion. In its selfless pursuit of truth, in its vision of order and beauty, it partakes of the quality of both. More and more it is beginning to make a profound esthetic and religious appeal to thinking people. Indeed, it may fairly be said that science is perhaps the clearest revelation of God to our age. Science is at last coming into its own as one of the supreme goods of the human race."

A botanic garden, with its opportunities for appeal to esthetic as well as to more purely intellectual interests, is in a peculiar position of advantage to fulfill the enriching purposes of science so forcibly stated by General Smuts. How unfortunate it would be for an institution like the Brooklyn Botanic Garden, whose program is conceived and carried out in the spirit of this broad grasp of the nature and possibilities of science, to be restricted and hampered in its work through any failure to realize that man does not live by bread alone, and that it is never so important, as during a period of economic (and therefore mental) depression, to nourish those agencies and institutions that minister to the cultural and intellectual needs of mankind.

While it is not, perhaps, reasonable to expect as large financial support during this time of economic stress as normally, the director ventures to express the hope that the nature and extent of our work during 1931, as reported in the following pages, may prove sufficiently convincing to command confidence in its value

to this community and to the advancement of science and education by and large.

Attendance

The total attendance for the year was 1,107,039. On Saturday and Sunday, April 18 and 19, approximately 29,000 visitors were registered at the entrance turnstiles. This is the largest week-end attendance since the Garden was established, and is nearly three times the attendance for the entire first year of the Garden. Probably at least 25,000 of this number came on Sunday. The weather was ideal and thousands of bulbs were in bloom in the lawns. At the Richard Young gate there were three lines abreast for nearly two hours, reaching from the turnstile to the curb. The attendance on the corresponding dates (April 19 and 20) for 1930 was more than 20,300. The annual attendance now equals nearly one-half the population of Brooklyn. The total attendance at all lectures and classes was 123,630.

It is a pleasure to report that an increasingly large number of people visit the Garden for the purpose for which it was established—to enjoy plants and to learn something of plant life. This is evidenced by the number observed reading and copying labels, asking questions of the guards and gardeners about the collections and about plants, discussing plants in flower, making detailed drawings and color sketches of individual plants and flowers, and in some cases studying the collections with a botanical manual in hand. More teachers from the high schools are bringing classes for outdoor plant study without depending on the services of a Garden docent.

Vandalism.—Closely connected with attendance is the problem of vandalism. It is specially gratifying to be able to report, as we have before, that vandalism has steadily diminished during the past two or three years. This is due largely to the presence of guards at the gates, supplemented by guards about the grounds; partly also to the fact that, the more beautifully and perfectly the Garden becomes developed, the more respect it receives from everyone. The condition would be almost ideal for a public garden if every entrance had a gate like the Richard Young gate at the south Flatbush Avenue entrance. This would practically eliminate entering the Garden after the gates are locked at dusk.

The wisdom of enclosing the Japanese Garden, Rose Garden, and Native Wild Flower Garden with separate fences, so that entrance to them can be more effectively controlled, and restricted to hours when guards are on duty, is increasingly emphasized.

One of our most pressing needs is the construction of suitable gates at each entrance.

Public Education

In 1516 Sir Thomas More wrote his *Utopia* in Latin, and never prepared an English version, intending it for the learned and not for the general public. For a hundred years after that scholars appeared afraid to entrust knowledge to the general public, but the movement for popular education gradually gathered momentum. A generation ago its chief instrument was the lecture platform—the lyceum and then the Chautauqua movement. As noted in the report of the Brooklyn Conference on Adult Education,[1] mass education is now largely provided for by the newspaper, radio, and magazines, so that "interest in lecture institutes and other devices for broadcasting science and art in wholesale fashion has largely waned, while the importance of small classes, individual study . . . (etc.) has become vital." "The Division of Adult Education of this Board (says the Eighteenth Annual Report of the Cleveland Board of Education) is not interested in mass education, but rather in the quality of the educational process."

From the beginning, the Brooklyn Botanic Garden has emphasized the importance of small groups in its educational work, and has developed a program of courses for comparatively small classes, rather than one of unrelated or even related lectures to large audiences. This, of course, militates against the largest attendance figures, but produces more substantial educational results, especially in connection with the free discussion encouraged in classes, and the practice of supplying printed and mimeographed syllabi and notes, which could not well be done with large lecture audiences. It is significant to find boys and girls who begin attending juvenile classes at the age of ten or twelve years, continue for six or seven years voluntary attendance in classes outside of school hours, or individual work under the guidance of an in-

[1] Lorimer, Frank. *The Making of Adult Minds.* Brooklyn, 1931.

structor. Many adults, also, enroll for courses year after year. Something besides mere information about plants results from such work.

More detailed reports follow from the curators of public and of elementary instruction.

School Service

City Wide.—Beginning with the Borough of Brooklyn, our service to the public elementary and high schools has gradually expanded until now it extends to all five boroughs. This includes supplying living and preserved plant material for study, Petri dishes filled with sterilized agar for the study of bacteria and other microscopic forms, penny packets of seeds for planting in school and home gardens, talks in schools, the loaning of lantern slides and accompanying text for lectures or talks by the teachers, conferences with teachers, visits of classes to the Garden, and other activities.

Conferences with Teachers.—It is significant that more than 6,600 teachers had individual and group conferences with members of staff concerning some aspect of their work in botany, nature study, or geography. The number has increased from 288 in 1929 to 3,731 in 1930, and 6,668 for 1931.

Attention is called to the table of statistics of school service on page 21, and in particular to the increase in the number of teachers borrowing loan lectures (with slides) from 97 in 1929 to 315 in 1931; also to the increase in the number of living plants supplied to beautify classrooms from 307 in 1929 to 420 in 1930, and 689 in 1931. More than 786,000 packets of seeds were supplied to school children in 1931 as compared to 740,791 the year before.

The preparation of lists of woody and herbaceous plants to serve as a basis for Field Tests by the Board of Examiners of the Board of Education in connection with examinations for the position of First Assistant (Head of Department) in High Schools, and the Course of Five Lectures for biology pupils in High and Junior High Schools and Maxwell Training School is reported by the curator of public instruction on pages 67–68.

Other details of cooperation with the schools are included in the appended reports of the curators of public and of elementary instruction.

TABLE I

Statistics of School Service

	1931	*1930*
Conferences with Teachers		
No. of conferences	67	49
No. of teachers involved	6,668	3,731
No. of pupils involved	397,512	196,590
Loan Lectures (Lantern Slides, etc.)		
No. of sets lent	36	33
No. of teachers involved	315	332
No. of pupils attending	13,387	13,756
Material Supplied		
Total number of requests from schools	934	437
Number of different institutions	222	137
High Schools and H. S. Annexes		
Brooklyn (Total No. 35)	30	25
Queens (Total No. 14)	10	10
Manhattan (Total No. 24)	17	14
Other Boroughs (Total No. 15)	13	9
Junior High Schools (Total in Brooklyn, 22)	20	22
Colleges and Universities (Total in Brooklyn, 7)	9	9
Training Schools (Total in Brooklyn, 2)	3	3
Elementary		
Brooklyn (Total No. 230)	70	29
Queens (Total No. 147)	7	1
Manhattan (Total No. 146)	2	3
Other Boroughs (Total No. 141)	1	1
Private and Parochial		
High	8	5
Elementary	17	6
Other Institutions	15	13
Number of potted plants for nature study	2,943	4,015
Number of Petri dishes filled with sterilized agar	5,482	5,226
Total number of teachers supplied with material	5,708	4,811
Total number of pupils reached	223,801	196,177
Living Plants Placed in School Rooms		
No. of schools	98	48
No. plants	689	420
No. teachers involved	1,703	1,406
No. of pupils reached	80,392	51,762
Plants Distributed (Raised in Classes)	20,515	16,165
No. of teachers taking plants	671	709
No. of children taking plants	915	1,596
Total number of schools represented	168	189
Seed Packets for Children		
No. of schools	352	429
No. of teachers	6,547	6,178
No. of pupils	261,871	246,965
No. of packets	786,393	740,791
Exhibits Provided		
No. of exhibits	8	17
Viewed by	52,150	42,600

Research During 1931

It would, no doubt, be misleading to say that the important thing about research is not the results of it but the continuation of it; and yet there is an element of truth in that assertion. If the modern world, called upon to choose between being deprived of the results of research which we all enjoy today and being deprived of the spirit of research, were to choose the former the world would come to an intellectual standstill that would make the Dark Ages seem like a blinding light. The really indispensable condition for progress is the spirit of inquiry. If modern civilization is in any respect superior to that of classic Greece, it is not because we have radio, aeroplanes, serums, improved vegetables, but because of the encouragement and diffusion among all the people of the attitude of mind that led to the invention of these things and the discovery of the fundamental principles that underlie them.

"What we know is but little, what we do not know is immense." These were the dying words of Laplace. "I hope we are now learning how to appreciate in a finite way a really infinite creation, even if we actually have to do it by infinitely small increments," said Dr. W. R. Whitney in his Sigma Xi address in 1928. How different is this outlook of the scientist from that of a certain botanic garden trustee (now deceased) who once said to his director; "If we know we can never find it all out, why try?" But one of the gems of psychological research is the discovery that under the guise of giving a reason for their opinions many people are only trying to rationalize them!

These comments were stimulated by the inquiry of a (non-resident in Brooklyn) contributor of funds who appeared to expect, at the end of one year, a volume of published results from a research project that involves the growing and subsequent hybridizing of plants that do not flower for two years after planting. Important and convincing as are the results of both pure and applied research, it is still one of the difficult and sometimes discouraging problems of the scientist to make the layman, who must finance it, understand it. The writer knew a man who provided for this Botanic Garden in his will with the restriction that none of the bequest should be used "for any experimenting"!

Long Views and Short Views

On pages 42–62 are statements concerning investigations under way at the Garden during 1931. These are to be interpreted as reports of progress. The writer has frequently been asked whether a problem of his own or of another has not been completed. The asker has not realized that almost every scientific discovery serves to disclose a whole new series of problems. One of the contrasts between business and science is that the business man, as James Truslow Adams recently noted, is from the very nature of his occupation apt to have short views and distrust all others. It was once said, as superlative praise, of the late J. Pierpont Morgan that he thought in ten-year periods. We must have long views in trying to evaluate and understand research—as, indeed, in planning the development of a scientific and educational institution; we must think in terms of a lifetime. We must not forget, for example, that after many physicians have spent most of their lives studying one organ of the human body there is still much to be learned about it; that Michelson spent a lifetime investigating the propagation of light; that after nearly thirty years of study of the destructive Chestnut Blight we are still unable to control it; that Darwin continued his research for twenty years before he began to write his "Origin of Species."

Registered Research Students

The number of persons applying to be enrolled at the Garden for research tends to increase. During 1931, the enrollment has been six—two registered at New York University for advanced degrees, two from the faculty of Hunter College (New York), one graduate of Wellesley College, and one teacher of botany in Abraham Lincoln High School. A report on graduate students and independent investigators enrolled during 1931 is given on page 62.

The Cost of Research

Research is expensive, but it is not a luxury. It costs less than war, or illness, or cosmetics, or chewing gum. The cost of one modern telescope would endow a substantial program of research at the Brooklyn Botanic Garden in perpetuity. Additional funds for this purpose are a fundamental need.

For more than ten years the Garden has been dependent on annual contributions of funds for much of its research that must be considered an integral and permanent part of its work. Moreover, a valuable and growing collection of living plants, such as the Garden now has, requires for its proper care, not only curators of plants and horticulturists, but also a department of plant pathology responsible for the control of plant diseases in our own collections as well as for the prosecution of research in plant pathology. Such a department has now become an absolute necessity at the Brooklyn Botanic Garden, and as soon as possible a permanent endowment fund should be provided. Not less than $500,000 of the one million dollars of additional endowment needed (see under "Financial," *infra*), is required for the endowment of research in pathology and closely related problems.

The Library

"Libraries may be considered as part of the laboratory of a man of science," said the great French physiologist, Claude Bernard, but he hastens to add: "this is on condition that he shall read the observations, experiments, and theories of his predecessors in order to know them and verify them in nature, and not to find opinions ready made in books, thus saving himself the trouble of working and of trying to further the investigation of natural phenomena."

This conception of the purpose of a library in a scientific institution, while needing emphasis in 1865, when stated by Claude Bernard, is now universally recognized. Since Bernard, however, a really stupendous change has taken place in the bulk of biological and especially of botanical publication. In 1865, a library of 1000 volumes would, perhaps, have contained all the really important botanical works, while the Brooklyn Botanic Garden, during 1931, received the current numbers of 937 periodicals devoted wholly or largely to botany, and accessioned 935 bound volumes. Many important items could not be purchased for lack of funds. Nine hundred and thirty-seven periodicals received means 937 books to be bound at the close of each year, in addition to the binding of numerous books originally bound in paper, and the annual binding-repair and rebinding of old and rare items purchased second hand.

Our list of desiderata for 1931, unpurchased for lack of funds, exceeds $1000. Many of these items are, each year, becoming more rare and more expensive. Our library budget for 1932 (adopted in December) provides, for publications, $700 less than for 1931.

The library budget of $13,745 for 1931 represents the income at 5½ per cent. on a capital sum of nearly $250,000. A portion of the personal service of the library ($1930) is met from the Tax Budget appropriation, but the larger part of this budget (84 per cent.), including most of the personal service and the entire cost of purchases, subscriptions, and binding is met from private funds. The annual maintenance cost of the library should be placed on a permanent basis by endowment.

Herbarium

The curator of plants reports the addition of 677 specimens to the Cryptogamic Herbarium, and the assistant curator of plants reports the mounting and incorporation into the Phanerogamic Herbarium of 11,254 specimens. On April 12, 4020 herbarium specimens were sent to the U. S. National Museum, Smithsonian Institution, on the basis of exchange. This was duplicate material from the collection of woody plants purchased by the Garden in 1917 from Dr. C. K. Schneider, of Austria.

The number of persons consulting the herbarium from outside the Garden organization was greater than at any previous year, and the number of specimens submitted for naming increases each year.

A Suggestion for Collectors and Donors

Since the Garden receives frequent offers of collections of pressed plants, it may, perhaps, be pertinent to remark here that such specimens are quite without scientific value unless accompanied with full data as to the definite place and date of collection, and the name of the collector. Each specimen should also include enough parts of the plant to make possible its determination or the confirmation of its determination if it has already been named; this includes flowers, leaves, and fruit where possible. The latter requirement should also be observed in connection with specimens submitted for determination.

Plantations and Grounds

There is developing in this country "a more and more widespread realization of our need for beauty as well as efficiency in land adapted to our use—beauty not merely as a luxury but as a practical necessity and as much a matter of course as practical efficiency. . . ." The quotation is from the official announcement of the School of Landscape Architecture of Harvard University. It may be a question as to whether beauty is ever a luxury, but there can be no question as to beauty being a practical necessity for a botanic garden, a park, or a city taken as a whole. Our problem, from the beginning, has been to develop the plantations in a way to make them beautiful and at the same time botanically educational. This has imposed certain limitations and restrictions. Landscaping could not proceed with the same freedom in the use of materials as in the planting of a private place or park. The number of visitors who come to enjoy the beauty of the Garden, as well as the almost daily presence of artists, during the flowering season, sketching and painting views as well as flowers, testify to the fact that the Garden has come to be considered as a place of beauty as well as of botanical interest.

The Laboratory Plaza

On January 14, the Commissioner of Parks, on behalf of the Botanic Garden, requested of the Board of Estimate and Apportionment approval of plans and specifications for repaving the walks of the Laboratory Plaza, constructing a brass-line compass and meridians, and two stone posts at the west entrance to the Plaza, at a total estimated cost of $3,725.00. This request, as usual, was referred to the Committee of the Whole of the Board on January 23 and, on the recommendation of the Committee, the request was approved by the Board on March 12.

After being publicly advertised for bids, the contract was awarded on April 14 to the lowest bidder, the Ross Galvanizing Works, Inc. (Albert Ross), of Brooklyn, whose bid was $3400. The highest of the five bids received was $4995.

Work actually began on June 1, but the official time did not begin until June 17, the time allowed for completing the work being 45 working days. The surfacing of the walks was rejected by the

engineer of the Park Department and the supervising landscape architect, and had to be done over. The walks were not completed until September 29. The panel of black Italian marble terrazzo, containing the geographic and magnetic meridians, was not completed until December 31—six months after the work on the contract was started.

The meridians are of brass strips with suitable terminal designs at each end. The geographic meridian is 20 feet long and 7/8 inch wide; the magnetic meridian 18½ feet long and 5/8 inch wide. The geodetic data at the ends of the meridians are as follows:

At the North End:

Magnetic north. Variation 11° 11′ west in 1931
Annual increase 4′

At the South End:

Altitude above mean sea level, 115 feet
North latitude, 40° 40′ 06″
Longitude west of Greenwich, 73° 57′ 48″
To the North Pole, 3416.7 miles
To the Equator, 2798.2 miles

This feature is in front of the main west entrance to the Laboratory Building. Even while temporarily installed it proved of much public interest, many persons pausing to copy the data. It is anticipated that the feature will be of special interest to classes in geography from the public and private schools.

We are greatly indebted to the American Geographical Society, Dr. Isaiah Bowman, President, for cooperation in determining the above data and accurately locating the meridians on the site. The work was done by Mr. Weld Arnold, of the Geographical Society's School of Surveying, and now of the School of Geography, Harvard University.

The completion of the large circular compass and sundial, as the central motif of this plaza, awaits available funds which we hope may be contributed in the near future. The amount required is approximately $1000.

Our own work in grading and soil improvement could not be commenced until November because of the contractor's delays, and all planting has had to be postponed until the spring of 1932.

It is planned to locate the Garden's collection of Magnolias on

this plaza, and a gift of approximately $1200 would provide the funds necessary for the planting. Such a gift by a garden club, woman's club, or other organization, or by an individual would be acknowledged by a suitable bronze tablet on one of the stone posts at the main approach to the plaza.

North Addition Contract

The final plans and specifications for this work were filed by the landscape architect, Mr. Caparn, with the Department of Parks on May 26, 1931. Bids were advertised for in the *City Record* of September 18, and opened by the Park Board on September 22. As the lowest bid (from the Ross Galvanizing Works, Inc.) was about $2000 in excess of the appropriation ($24,100), all bids were rejected.

Revised plans and specifications were advertised for public bids on December 16 and opened on December 29. The lowest bid this time exceeded the amount available by $975.50. The year closed, therefore, with the contract not awarded.

Native Wild Flower Garden

The planting of the Local Flora Section has progressed during the year along ecological lines rather than systematic as before (previous to 1924). Special features are the Bog and the Sand Barren Pool. This work has been under the curatorial supervision of Dr. Svenson, who has made numerous collections within the native wild flower area (roughly, a radius of 100 miles from Brooklyn).

The Rose Garden

"Municipal rose gardens are an investment in citizenship, paying quicker returns than anything else," said the president of the American Rose Society at its annual meeting last June. The Rose Garden of the Brooklyn Botanic Garden has increased in beauty and popularity each year since it was first opened to the public in 1928. Rose Garden Days were held on June 15 and October 9 (see p. 72).

The Japanese Garden

A special contribution of private funds ($1500) expressly for the Japanese Garden has made possible during the year much

needed attention to the trees and shrubs by native Japanese gardeners under the supervision of Miss Averill, honorary curator of the garden. This has included what is known as the "plucking" of several of the pine trees—the removal of certain leaves, in accordance with approved Japanese practice. The top of the high hill, "Heaven," has also been reshaped and made several feet higher.

The demand for the published "Guide to the Japanese Garden —Guide No. 4" (Brooklyn Botanic Garden RECORD, July, 1930) has been so great that the Guide is now out of print.

The Children's Garden

The Children's Garden has been very successful this summer, both from the standpoint of crop and educational results. Contrary to expectation, the attendance was not affected by the infantile paralysis epidemic. In fact, some parents were advised by physicians that our Children's Garden was a safe place to be under such circumstances.

Conservatories

The attendance at the conservatories has more than doubled during the year, and almost trebled in three years—32,880 in 1929; 40,093 in 1930; and 84,429 in 1931. The largest single day's attendance since the conservatories were opened was on April 19, 1931 when 3105 visitors were recorded in two and one-half hours.

Cooperation

Long Island University.—As a result of a conference with Prof. C. M. Wendel, Chairman, Committee on Instruction of Long Island University, on January 13, an arrangement has been entered into by the terms of which Long Island University agrees to accept for undergraduate credit courses given at the Botanic Garden which conform to academic standards approved by that University. The professor of botany in the University has been made resident investigator at the Garden and will serve in an advisory capacity, especially with reference to economic plants in which he has specialized. The full text of this *Agreement* is given on pages 142–144 as Appendix 8.

Daughters of the American Revolution.—On May 6 the "Women of '76" Chapter, National Association, D. A. R., held an all-day meeting at the Garden, with luncheon in the Laboratory Building. After the meeting the Chapter made a gift of $5 to our Department of Elementary Instruction and another gift of $15 for a tree in honor of George Washington. In November, the Chapter contributed $36 for a bronze tablet to mark this tree.

American Federation of Arts.—On May 18, a garden party was given to the American Federation of Arts on the occasion of its annual meeting held at the Brooklyn Museum. Photographs showing the use of plants in design, paintings of flowers, and books in the Library demonstrating botanical illustration from 1483 to the present were exhibited. Tea was served by the Woman's Auxiliary.

American Iris Society.—The Annual Meeting of this Society was held at the Garden on June 30, with an attendance of about 354. Sessions were held in the forenoon followed by luncheon in the Laboratory Building. The afternoon was devoted to visiting Iris gardens on Long Island.

The Regional Plan of New York and Its Environs.—The final volume (Plan Volume II) of the elaborate report of this important organization is entitled *The Building of the City.* On request, the Garden supplied a photograph of a school class visiting the Rose Garden for a lesson.

Long Island Ten Year Plan.—A statement concerning the plans of the Brooklyn Botanic Garden for the next few years was prepared for the *Brooklyn Daily Eagle,* which devoted its issue of October 25 to the promotion of this plan. Four colored illustrations of proposed permanent improvements were also supplied for the public exhibit installed by the *Eagle* in its building and open free to the public during the fall.

Other Organizations.—Among numerous cooperations with other institutions may be mentioned the sending, by request, of seeds of 25 species of native wild plants of the Eastern States to the Kansas State Board of Agriculture for naturalizing there; examination of the soil of the grounds of the Visiting Nurses Association, Brooklyn, and suggestions for soil improvement; a similar service to Brooklyn Hospital; information to the Depart-

ment of Education, Massachusetts, concerning our educational work; seeds of *Sorghum* from pedigreed plants supplied to the College of the City of New York for use in demonstrating to students in Genetics the principles of Mendelian heredity.

Miscellaneous.—Since May, 1930, we have been caring for seedlings of Getah-Jelutong for a commercial firm interested to secure growth data concerning them. Getah-Jelutong is Pontianak rubber, obtained from several species of *Dyera,* found wild in the Malay peninsula, Dutch East Indies, Sarawak, and Borneo. The crude product, a milky juice or latex, contains about 12–14 per cent. of a so-called "rubber" (Geta meaning "gum"), and about 50 per cent. of resin. This "rubber" is used as an inferior substitute for gutta percha, or in combination with the purer gum for the manufacture of an inferior class of goods. Most of it is used in the United States in the manufacture of chewing gum.

We are also caring for seedlings of *Solanum indicum,* a relative of the potato, for an investigator connected with the New York Homeopathic Medical College and Flower Hospital, who is conducting medicinal studies of this plant.

Cooperation with Relief Agencies

The Mayor's Committee

It will be of interest to record here the cooperation of the Garden with regular social service organizations (the Brooklyn Bureau of Charities and the Association for Improving the Condition of the Poor), and with the Emergency Unemployment Relief Committee (known from the names of its chairmen as "the Prosser Committee" (in the spring), and "the Gibson Committee" (in the fall), also as the "Emergency Work and Relief Bureau"), and with The Mayor's Official Committee for the Relief of the Unemployed and Needy. Employees of various City Departments contributed one per cent. or more of their salaries during the first six months of 1931, and this money, together with other donations from private sources, provided a fund in excess of $1,600,000, which was distributed by the Mayor's Committee to provide work and wages for those thrown out of work by the economic depression. In recognition of this, the employees of

the Brooklyn Botanic Garden voted voluntarily to assess themselves for four months (December–March) one per cent. of their salaries or partial salaries received from the tax budget. With the acquiescence of the Mayor's Committee, the amount thus raised was added to the Garden's own personal service budget to prolong the period of employment for per diem employees. Similar pledges were made in December, 1931, for a period of five months. This, notwithstanding the fact that many of our employees through lodge, church, or other agencies, had already made contributions for unemployment relief. The response was spontaneous and whole-hearted, and all the more so in view of the fact that our own temporary per diem employees were to be the beneficiaries. The occasion was recognized as an opportunity to serve the Botanic Garden as well as to meet an existing emergency. The director is pleased to record here his receipt of expression of appreciation of these contributions by the Governing Committee of the Garden and also by Mayor Walker on behalf of the Mayor's Committee.

One of our generous anonymous contributors also made two special contributions of funds (totaling $1275) in order that one of the temporary employees might not have to be laid off.

Emergency Work and Relief Bureau

This Bureau is the distributing agency of the Emergency Unemployment Relief Committee. Between January 1 and July 1, as many as 23 temporary employees were engaged at one time in various capacities in the Laboratory Building, and six on the grounds. The indoor people (2 men and 21 women) worked five days a week at $3 a day, and the men outdoors three days a week at $5 a day. The indoor employment included stenography, typing, office and library assistance, curatorial assistance (administrative), translating botanical works from foreign language into English, herbarium assistance, telephone switchboard, etc.

During the last half of the year, there was a change in the personnel of these employees, some being discontinued and others assigned. At the close of the year the total number was 19 women and five men in the building, and 14 men in the laboring force outdoors.

Other Agencies

In addition to those from the Emergency Work and Relief Bureau there were, during the last half of the year, six men in the outside per diem force whose wages were paid by the Brooklyn Bureau of Charities, and one from the Association for Improving the Condition of the Poor.

The total number from all relief agencies was, at the close of the year, 45 (26 men and 19 women).

Further reference is made on pages 88–89 to the work accomplished in the Herbarium by these special assistants.

The profitable employment of so large a number of extra help, approximately doubling our regular force of assistants, emphasizes how greatly we are normally undermanned. Much of this extra force could be continuously profitably employed.

It should not be overlooked that the taking on of so large an extra force involves a great deal of additional janitorial work, increased work in the business office, and increased consumption of electric current for light. It also necessitates additional equipment, such as typewriters, desks and chairs, miscellaneous office equipment, and additional miscellaneous supplies, for all of which no additional appropriation has been made from either the Tax Budget or private funds. On the whole, however, the arrangements have been of mutual benefit to the Garden and the employment agencies, and it has been gratifying to know that the Garden was able to cooperate in a social service where the need was so urgent.

Exhibits

In addition to the exhibit held at the Garden in connection with the annual Spring Inspection (p. 36), seven exhibits have been held elsewhere. These are recorded in detail in the reports of the curators of public and of elementary instruction on pages 68–71 and 78.

Guide Books

Rock Garden Guide.—The Botanic Garden RECORD for May was issued as a "Guide to the Rock Garden—Guide No. 5," and received widespread newspaper publicity. Nearly 450 inquiries

and requests were received by mail within one month from eighteen states, and nearly 340 copies were sold within the same period. This reflects the great increase in interest in rock gardening in America during the past few years. The construction of the Brooklyn Rock Garden (one of the first, and possibly the first, in a public garden in North America) has been an important factor in stimulating and fostering this interest.

Japanese Potted Trees.—The RECORD for November was a guide to the excellent collection of 32 Japanese dwarf potted trees (*Hochinoki*), presented to the Garden by Mr. Ernest F. Coe of New Haven, Conn., in 1925. Numerous expressions of appreciation for this guide (Guide No. 6) have been received, and the Garden has granted the request of the editor of *La Tribune Horticole*, Brussels, to reprint the entire guide, and has loaned the halftone blocks for the illustrations.

Eleven Months of Bloom

In 1930 we were able to report an unusual period of twelve months' bloom, beginning with *Iris Vartani* in January. In 1931, no flowers were observed outdoors in January, but Snowdrops (*Galanthus Elwesii*) were in bloom in February and Vartan's Iris was in full bloom in the Rock Garden on Christmas Day. On December 22, the unseasonable official outdoor temperature of 55.8° F. was recorded by the Weather Bureau. This was the warmest recorded for that date since the 56° F. record for New York City established in 1875. Numerous roses were in flower in the Rose Garden as late as Thanksgiving (November 26).

Gifts

An unusually large number of gifts was received during the year. Among those especially to be noted are:

February 7. From Mr. and Mrs. Edward C. Blum, $150 for a Garden seat. This has been located north of the Japanese Garden near the Bubbler Drinking Fountain and two other seats given by Mr. and Mrs. Blum in 1929.

March 2. $200 through Mr. George E. Brower, treasurer of a fund started for the Prospect Park Zoo, but not required owing to the fact that the plan was not carried to fulfilment. Of this

fund $150 had been contributed by Mr. Frank L. Babbott, and $50 by Mr. Edward C. Blum, honorary president and president, respectively, of our Board of Trustees.

April 18. From the Woman's Auxiliary, $100 toward the cost of publishing the colored plate of beardless Iris in the Botanic Garden RECORD for July.

April 20. Anonymous, $1000 for personal service, wages, to prevent the laying off of an employee. A subsequent contribution of $275 was received from the same donor for the same purpose of October 13.

August 18. From Mrs. Henry C. Folger, $1000 as a permanent fund for the maintenance of the Shakespeare Garden. This gift came through the treasury of the Woman's Auxiliary, Mrs. Glentworth R. Butler, chairman, Mrs. F. J. W. Diller, secretary-treasurer.

The full list of gifts may be found on pages 117–125. They have all been acknowledged, as received, with the thanks of the Governing Committee and the director. It is a great pleasure to make public acknowledgment of them here, and especially of the interest in the Botanic Garden of which they are such substantial evidence.

Membership

The number of members of all classes enrolled at the close of the year (not counting duplications of those enrolled in more than one class) was 1125, as against 1078 at the date of publication of the preceding annual report (February 25, 1931), a net gain of 47. This is a better showing than might reasonably have been expected during a period of severe financial stress, and reflects increasing popular interest in the Garden. The increase is due largely to the special efforts of the membership committee of the Woman's Auxiliary during the summer and fall. The membership of the Garden is, however, smaller than it should be in a borough of more than two and one-half million inhabitants, and there should be a substantial increase in the enrollment with the return of normal economic conditions.

Distribution of Plants

The seventh annual distribution of surplus plants to members took place on May 22. More than 2600 Chrysanthemums and Hardy Asters were distributed to 217 members who called for them at the Garden. In September 3950 roots of Iris were distributed—a total for the year of 6554 plants.

Flower Days

Flower Days, for members and their friends, continue to increase in popularity and attendance. A fuller report is given by the curator of public instruction on pages 71–72.

Seventeenth Annual Spring Inspection

The seventeenth annual Spring Inspection was held on the afternoon of May 12 (the second Tuesday in May, as usual). Notwithstanding threatening weather and slight showers, there was an attendance of about 600, and the occasion was altogether very enjoyable, due chiefly to the work of the officers and members of the Woman's Auxiliary which had charge of the social arrangements. Numerous new features of the grounds were included in the Garden Walk, after which the members and guests returned to the Laboratory Building for tea and to view the following exhibits:

1. 500 Paintings of Flowers of India, by Mr. John Alexander Descubes. Mr. Descubes, who was in the Government official service in India from 1882 to 1929, devoted 47 years to making 5000 of these paintings. They were exhibited through the courtesy of The Overseas Eastern Service, Aligarh (U.P.), India, represented by Mr. K. K. Shah. A special medal was granted M. Descubes by Queen Victoria after her personal inspection when these paintings were exhibited at the Calcutta International Exhibition, 1883–1884. The artist also received several other medals and certificates of merit for his work.

2. Forty Photographs of Plants and Plant Parts, by Mr. Edward Weston, Carmel-by-the Sea, California, illustrating the use of plants and plant parts as source material for design. The arrangement for this exhibit was made through Mrs. Alma Reed, of The Delphic Studies, Manhattan.

3. One Hundred Herbarium Specimens of plants collected in Alaska by Mrs. Inez Mexia, and presented to the Botanic Garden by Mrs. Adrian Van Sinderen, a member of the Woman's auxiliary. These were selected from a total of 243 specimens presented.

4. Library Exhibit. The following beautifully illustrated works were on exhibit in the Library:

a. Chrysanthemums: Selected creations cultured and introduced by Yuho Kikuchi and Taichiro Kimura. Takara zuaka, Hyogo Prefecture, Japan. Volume I, text, and Volume II, comprising 50 colored plates.

This work was presented in November, 1930, by six members of the Woman's Auxiliary and one other friend of the Botanic Garden.

b. Illustrated Catalog of the Okura Exhibition of Japanese art held at Rome, April–May, 1930, under the auspices of the Italian government. Two large folio volumes, comprising 125 plates, including many reproductions of Japanese flower paintings. This catalog was received in November, 1930, as a gift from Baron Kishichiro Okura, Tokio.

c. Collection of sixteen Japanese prints featuring Iris. These were obtained by purchase by Dr. George M. Reed during his trip to Japan to study Iris, in 1930.

Changes in Personnel

There have been only two changes in the Garden personnel during the year. Miss Belle H. Burr, curatorial assistant in the Herbarium, resigned July 31, and Mrs. Margaret Burdick Putz, formerly of the Garden personnel, was appointed in her place beginning August first.

Dr. Ralph H. Cheney, professor of biology and chairman of the department, Long Island University, was on May 25 appointed Resident Investigator, beginning as of July 1, 1931. Dr. Cheney has specialized in the botany of economic plants, and his appointment will extend the range of botanical science represented in the Garden organization.

Woman's Auxiliary

The Auxiliary held its first spring meeting at the Garden on April 13. After the business session, two motion picture reels (16 mm.) of views in the Garden taken and projected in natural color, were shown. The Garden has since acquired a motion picture camera for taking pictures in natural color and a projector for exhibiting them.

During the summer, the Auxiliary initiated a special activity in the interest of extending a knowledge of and interest in the Brooklyn Botanic Garden on Long Island, especially outside the limits of Greater New York. Members of the Auxiliary were hostesses at four meetings during the summer and fall at Fort Salonga, Roslyn, Shelter Island, and Bellport; and three meetings of Women's Clubs were held at Bay Shore, Forest Hills, and Plandome, Long Island, at which the Botanic Garden was featured. The meetings were addressed by members of the Garden staff. Special courses were also offered in the fall for Long Island women and others, under the joint auspices of the Auxiliary and the Garden. In addition to extending an interest in the Botanic Garden, 59 new annual members were enrolled. It is a pleasure to express here cordial appreciation of this effective work.

Financial

Endowment Increment

For the first time we are able to report a total endowment of One Million Dollars. The exact amount, as of December 31, 1931, was $1,003,719.29. The amount of the increase during the year was $12,420.16. It is gratifying to be able to report any increase at all considering the unfavorable economic conditions. All but $1000 of this increase was due to the Endowment Increment Plan, adopted by the Governing Committee on January 11, 1921 (the last meeting attended by Mr. Alfred T. White). By this plan, only 80 per cent. of the income of certain funds was expended from 1921 to 1930, the remaining 20 per cent. being invested as the principal amount of our Endowment Increment Fund, and the accrued interest on this fund was added to the principal. At the beginning of 1931 the amount to be set aside

from the income of the various contributing funds was reduced to 10 per cent. By this plan the principal amount had become $103,338.40, as of December 31, 1931.

This plan has not involved any serious impairment of the work of the Garden, and if it can be continued it will, in time, provide a substantial addition to the permanent endowment for our scientific and educational work. The plan contemplates that ultimately each contributing fund shall be reimbursed pro rata to the total of its annual contributions to the Endowment Increment Fund.

The period of financial stress through which the entire world is now passing serves to emphasize the importance to scientific and educational institutions of not having to depend largely upon annual contributions, which fluctuate with the number and prosperity and understanding interest of the contributors. The cost of their maintenance and work should be provided for in some permanent manner so that they will not suffer periodic impairment with the fluctuations of business prosperity which are bound to recur in the future as they have in the past. The weakest point in the financial condition of the Brooklyn Botanic Garden is the extent to which it is dependent on annual contributions of funds for the financing of essential activities which should be considered a permanent part of its work. Every effort should be made to place these activities, as soon as possible, on the basis of a permanent endowment. I have, on several previous occasions, pointed out that to provide for work already organized but not endowed, and to provide for the normal expansion and enrichment of our work during the next few years will require the income at 5½ per cent. on one million dollars of additional endowment. Compared with the provision made for botanical work in other places, this is a very modest sum.

The City and the Garden

The Tax Budget appropriation for maintenance of the Garden in 1931 was as follows:

	Requested	Granted	Change from 1930
Personal service	$122,954.00	$ 82,660.	$ .00
Other codes	28,446.37	18,740.	2470.00 (Decrease)
Totals	$151,400.37	$101,400.	$2470.00

The Private Funds Budget was $110,346.43, $8946.43 in excess of the Tax Budget.

The percentages of the two budgets for the past five years are as follows:

	1927	1928	1929	1930	1931
Tax budget	43%	48%	43%	44%	48%
Private funds	57%	52%	57%	56%	52%

Collections Fund Contributions

For the purchase of all publications, plants, and specimens, and for a considerable portion of the personal service, the Garden is dependent on private funds. A part of the total amount required is obtained by contributions solicited annually. The needs tend to increase each year, but the amount of the contributions has tended to decrease since 1927, as follows:

	1927	1928	1929	1930	1931
From within the Board	$2,350	$1,925	$1,850	$ 935	$1,175
From without the Board	7,532	5,495	5,432	5,604	5,587
Totals	$9,882	$7,420	$7,282	$6,539	$6,762

These figures emphasize the statement on the preceding page of the urgency of making permanent provision for permanent needs.

Appended Reports

Reports on the research work of the Garden for 1931, administrative reports of the various departments, and Appendices 1–7 follow as an integral part of this report. These all contain important information for those interested in the progress of the Garden and of botanical science and education.

Respectfully submitted,

C. Stuart Gager,
Director.

FIG. 2. Tender Waterlily Pool and Laboratory Building. Artist painting flowers. (Photograph by Mrs. Frank Johnson.)

REPORTS ON RESEARCH FOR 1931

Plant Pathology

By George M. Reed

Studies on the Inheritance of Resistance of Oat Hybrids to Loose and Covered Smut

In the Annual Report for last year we described briefly the experiments on the second generation plants of a large number of different oat hybrids involving various combinations of smut resistance. Altogether, the second generation plants of fifty-two different crosses were studied. During the past season we have grown a large number of third generation progenies from most of these hybrids. Usually, two sets of seed from each progeny were planted, one set inoculated with the loose smut and the other with the covered. Altogether, more than 3,000 different sets of F_3 progenies were grown, each one including 20 to 25 individuals.

As described in the previous report, these various oat hybrids involve quite distinct types of combinations of smut resistance; at least six different groups of hybrids from the standpoint of smut resistance have been studied:

1. In the first group, one variety resistant to both loose and covered smut was crossed with another variety which is susceptible to both smuts. In the hybrids Hull-less × Black Mesdag, Silvermine × Black Mesdag, and Early Champion × Black Mesdag, we have the combination of Black Mesdag, entirely resistant to both smuts, while the other varieties are susceptible. Additional data on these different hybrids were obtained during the past year. These, together with the data obtained in previous years, have been assembled and are practically ready for publication.

A series of similar crosses involving the variety Markton, which is resistant to both smuts, crossed with the susceptible varieties Canadian, Early Champion, and Victor, have been made. Many third generation progenies of these crosses were grown, and the results were in fair harmony with those obtained for the second generation.

2. A second group of hybrids involves the combination in which one parent is resistant to both smuts while the other parent is susceptible to the loose, but resistant to the covered. The third generation progenies of a hybrid between Early Gothland and Markton were grown during the past season.

3. A third type of cross is between one variety resistant to both smuts, while the other is susceptible to the covered but resistant to the loose. This is the reciprocal of the preceding type of cross. Third generation progenies involving Markton, a variety resistant to both smuts, with Monarch, a variety susceptible to the covered smut but resistant to the loose, were grown during the past year.

4. A fourth type of hybrid involves a parent susceptible to both smuts, while the other parent is susceptible to the loose smut but resistant to the covered. Very extensive data have been obtained in hybrids involving Early Gothland × Hull-less, and Early Gothland × Victor. The data were rounded out by the results secured during the past season and are now in the press.

Several third generation progenies of other hybrids of this type were also grown during the past year. These involve the varieties Orientalis × Victor, and Scottish Chief × Victor. The Victor variety is susceptible to both smuts, while the other two varieties correspond to Early Gothland in their susceptibility to loose smut, but resistance to the covered.

5. A fifth type of hybrid includes crosses between a variety susceptible to both smuts and another variety susceptible to the covered smut but resistant to the loose. Such hybrids are analogous to those recorded in Group 4. Extensive data have been obtained with crosses involving Hull-less and Monarch. These data have also been prepared for publication and are now in press.

6. A final group of hybrids includes crosses between one variety susceptible to the loose smut while the other is susceptible to the covered. During the past year we have published our data on certain crosses between Early Gothland and Monarch. The data were obtained for the second, third, and, to some extent, for the fourth generation of the hybrids. The third generation progenies of additional crosses involving this same combination of parents were extensively grown during the past season. All these crosses

involve Monarch, a variety highly susceptible to the covered smut and extremely resistant to the loose. It has been crossed with Rossman, Danish, Danish Island, Orientalis, and Scottish Chief, all resistant to the covered smut and susceptible to the loose.

A number of additional crosses between certain varieties were made. These involve further new combinations of resistance to the two smuts of oats and when the studies are carried out on the second, third, and later generations, additional light should be thrown on the method of inheritance of the smut resistant quality.

Some of our studies on the general problem of oat smut investigations are in cooperation with Mr. T. R. Stanton, Senior Agronomist of the Office of Cereal Crops and Diseases at Washington, D. C. Mr. Stanton has furnished some of the material for the study of the hybrids, and is also testing out from the agronomic standpoint some of the lines which are promising on account of their smut resistance.

Physiologic Races

We have already demonstrated the existence of many specialized races of both loose and covered smut of oats. Recently an interesting specialized race of the covered smut has been isolated. The collections of the material were received from Mr. T. R. Stanton. The new race is particularly interesting because of its ability to infect the Fulghum variety of oats. This is a variety that is commonly grown in the Southern United States and has proved to be highly resistant to most other races of the covered smut.

Of even greater interest is the fact that Black Mesdag is susceptible to this newly discovered race of covered smut. Black Mesdag has for many years shown a very high degree of resistance to all collections of both loose and covered smut. Many distinct races of both smuts have been tried on this variety, but with negative results. It turns out, however, that the newly discovered specialized race of covered smut on the Fulghum type of red oats is capable of infecting Black Mesdag.

Two different collections of the smut on Fulghum oats were made by Mr. Stanton and forwarded to me for investigation. The spores from each collection were sown on twenty-four varieties of oats. One series of plants was grown in the greenhouse, and additional tests were made in the field following the discovery of

the susceptibility of Black Mesdag. In the greenhouse and in the field a total of 77 plants of this variety inoculated with one collection were grown, and 44 (57.1 per cent.) were infected; 45 plants were inoculated with the other collection and of these 22 (48.8 per cent.) were infected. In both cases approximately 50 per cent. of the inoculated plants were smutted.

Positive results were obtained with both collections on such varieties as Hull-less, Green Mountain, Canadian, Victor, Early Champion, Monarch, and Joanette, as well as Fulghum and Kanota. In most cases, 100 per cent. of the inoculated plants were smutted. One of the collections infected a few plants of *Avena brevis* and *A. strigosa*. Several other varieties, however, gave entirely negative results; these included Scottish Chief, Danish Island, Early Gothland, Monarch Selection, Orientalis, Danish, Rossman, and Markton.

Cultural Characteristics of the Oat Smuts

A detailed study of the characteristics of the various collections of races of both loose and covered smut in culture has been undertaken by Mr. L. Gordon Utter. Many of the races are sharply differentiated by their capacity for infecting certain varieties of oats. The problem, then, is to determine whether corresponding differences exist in the characteristics of these races as grown in artificial media in the laboratory. Further infection experiments are being carried out with pure line cultures thus obtained. Interesting progress has been made during the past year.

Sorghum Smuts

A series of second generation plants of a large number of sorghum hybrids was inoculated with both the loose and covered smut. It was possible to grow these through the courtesy of Dr. R. A. Harper, who provided land on his farm near Ridgewood, New Jersey. Valuable additional data on the inheritance of smut resistance in these sorghum crosses have been obtained.

During the past few years a large amount of material of various sorghum hybrids has been collected in connection with the smut resistance studies. Miss Elizabeth Marcy has undertaken a study of the morphological characters of the hybrids with a view to

determining their possible association with the smut-resistant quality.

Forest Pathology

By Arthur Harmount Graves

Breeding Work With the Chestnut During 1931

As in former years, the research work with the chestnut has been carried on in collaboration with the Division of Forest Pathology, Bureau of Plant Industry, U. S. Department of Agriculture. The work has consisted of a continuation of the hybridizing experiments with the Japanese chestnut, *Castanea crenata,* and the American chestnut, *C. dentata,* with a view to securing, if possible, a stock which inherits the parental characters which are desirable from the standpoint of forestry—namely, the disease resistance of the Japanese, and the tall-timber-growing character of the American.

In this hybridizing work of the year before, as stated in the Brooklyn Botanic Garden Record (Vol. 20, p. 87), ten nuts were secured, all presumably hybrids. It is with profound regret that I have now to report that not a single one of these nuts germinated. As stated in the report of last year on this work, the nuts were stored during the winter (until the end of January, 1931) in the cool propagating house of the Conservatories, in sand and slightly dampened sphagnum moss. On January 30 they were planted in 4-inch pots, some in loam and some in clean sand, and all were placed in the warm propagating house. Instead of germinating, decay set in, and by April 1 all had rotted.

In spite of this discouraging setback, we have this year more than quadrupled our efforts in the pollination work, and have changed somewhat the method used for germination of the nuts. With the help of Miss Rusk, 240 flowering branches of six Japanese chestnuts were bagged and pollinated with pollen from American chestnuts, as against 50 branches in the previous year on three Japanese trees. Of the three new trees worked with, two are on the property of Mr. Howard N. Folk, at Brielle, Monmouth Co., N. J., and the third belongs to Mr. John W. Minturn, Syosset, Long Island (township of Oyster Bay). We are pleased to acknowledge here the cordial cooperation of these

owners and also the continued interest and cooperation of the owners of the three other trees, namely Mr. Beekman Winthrop, Mr. Bronson Winthrop, and Mr. Renville S. Smith.

It is indeed a pleasure to report that as a result of the more extensive pollinations of 1931, 124 nuts were secured in the fall (Table II). On the advice of the Division of Forest Pathology,

TABLE II

RESULTS OF CROSS POLLINATIONS, 1931

Owner Location	Folk Brielle	Winthrop O. Westbury	Hammond [1] Syosset	Minturn E. Norwich	Smith O. Bay	Totals
No. of branches bagged.....	23	47	72	11 (plus 2 selfed)	87	240
No. of branches bearing nuts ..	9	4	6	1	39	59 (24.5%)
Total no. of flowers pollinated [2]....	41	83	144	16 (omitting those selfed)	321	605
Flowers developing nuts....	10	5	7	1	68	91 (15%)
No. of nuts ripened.....	14	5	10	1	94	124

[1] Although on the estate of Mr. Bronson Winthrop, this tree has been so designated, after the present tenant, to distinguish it from the tree belonging to Mr. Beekman Winthrop.

[2] A "flower" here means a flower cluster (see Fig. 3). Usually three flowers make up a flower cluster, surrounded by the involucre which later develops into the "bur" of the chestnut. In case all of the three flowers are fertilized, three nuts in the bur are the result. It is evident from the table that the trees bear usually more than one flower cluster on a branch. This means either that several androgynous catkins are borne on one branch, or that the androgynous catkin, if single, bears more than one flower cluster. In the case of the Smith tree both of these statements are true. It was not uncommon to find on this tree four flower clusters on one catkin. The number of pistillate flower clusters on the androgynous catkins is fairly constant in each individual tree.

U. S. Department of Agriculture, and of the Boyce Thompson Institute, these were planted immediately after harvesting. Before planting, each nut was given a number, weighed, and measured as to its greatest length, breadth, and thickness. All were planted in 4-inch pots or large pans, some in sandy soil obtained from the

Oyster Bay region where three of the Japanese parents are growing, some in clean gravel, and the rest in a mixture of sand, garden loam, and leaf mold. They have been kept in the cool propagating house, and up to the close of the year there has been no indication of germination, although most of the nuts seem sound.

The most significant thing shown by this large harvest is the demonstration that with persistence and properly timed effort plenty of crosses *can* be made between the American and Japanese species and sound nuts secured. The methods used have already been described in my report for 1930, but a brief resumé will be given here. A reference to Fig. 3 will make the situation clearer. The chestnut trees to be pollinated must be visited before the lower or staminate catkins have commenced to shed their pollen. At this time not only these catkins, but also the part of the androgynous catkins above the pistillate flower clusters (the latter indicated by the white arrows) must be cut off, and the remnant of the branch, now bearing only the pistillate clusters, enclosed in a bag. A few days later, when the pistillate clusters are presumably receptive, the tree is again visited, the bags removed, and the pistillate flowers rubbed gently with staminate catkins taken from an American chestnut tree. The bags are then replaced. To increase the chances of fertilization, this operation is repeated once or twice more, at intervals of from three to six days, and then the bags are left on until no more pollen is being shed by the other flowering branches of the tree. In September the nearly mature burs are again enclosed in the bags in order to prevent loss from their dropping to the ground or shedding their nuts. Finally, when the burs have opened inside the bags, the nuts are collected. The whole process necessitates six or seven visits to the trees. Table III presents a time-table of the crossing work in 1931.

Sources of the American Pollen.—Since the times of flowering of the Japanese trees are in most cases earlier than the flowering period of the native chestnut in this vicinity, it is necessary to use pollen shipped from a more southern latitude, where the American chestnut blooms earlier. Generous quantities of this American pollen were shipped to us at the proper time by the Division of Forest Pathology, U. S. Department of Agriculture, Washington, D. C., and also by the Ohio Agricultural Experiment Station,

FIG. 3. Flowering branch of Japanese chestnut (*Castanea crenata*) belonging to Mr. Howard N. Folk, Brielle, Monmouth Co., N. J.; collected June 28, 1931. The purely staminate or *androgenous* catkins borne on the lower portions of the two flowering branches are in full flower, shedding an abundance of pollen. The upper catkins (two on the right hand branch and one on the left) are *androgynous*, *i.e.*, with pistillate flowers at their bases (indicated by the white arrows and the protruding, spine-like styles), which will form the burs, and with still unopened staminate flower clusters above. (7481.)

Wooster, Ohio. It is hardly necessary to state that our results could not have been attained without this splendid cooperation, which we are pleased to acknowledge here. Later in the season (beginning, in 1931, about July 4) the American chestnut sprouts, of which there are many in this vicinity, open up their flowers, and this pollen was used (in part) for the last pollinations.

Analysis of Results in 1931.—The results this year (Table II) show that 24.5 per cent., or nearly one quarter of all the branches pollinated, bore nuts. 15 per cent. of all the pistillate flower clusters on the branches bore nuts—many of the burs having two or even three nuts. In one case one branch on the Smith tree bore nine nuts in four pistillate flowers. In other words, four burs

TABLE III

TIME-TABLE OF CHESTNUT WORK, 1931

Owner	Folk	Winthrop	Hammond	Minturn	Smith
Location	Brielle	O. Westbury	Syosset	E. Norwich	O. Bay
Pollination:					
Branches bagged	June 18	June 24	June 23, 24	June 23	June 26
1st pollination	June 27, 28	June 26	June 29	June 29	July 1
2d pollination	July 3, 4	July 2	July 2	July 2	July 7
3d pollination	—	July 8	July 8	July 7	July 10
Bags removed	July 15	July 28	July 28	July 28	July 28
Harvesting and planting:					
Burs bagged	Sept. 10	Sept. 17	Sept. 17	Sept. 17	Sept. 17
Nuts collected	Sept. 25	Oct. 2	Oct. 2	Oct. 2	Oct. 12
Nuts planted	Oct. 3	Oct. 4	Oct. 5	Oct. 4	Oct. 16

were formed on this branch. Two of the burs contained three nuts each; one, two nuts; and the fourth, one. It is significant that this branch was located near the top of the tree, where pollinations were made in order to determine whether the results would be better here than in more accessible branches, which could be reached either from the ground or from a step-ladder. Of the seven branches pollinated near the top of this tree four yielded nuts, and of the 26 pistillate flowers pollinated on these seven branches ten yielded nuts. These results show a much higher percentage of success than the average for this tree. Only further work, however, can determine whether this is the general rule. Of course the operation becomes much more difficult if one has to climb each tree, as in this case, seven times during the season.

As will be seen from Table II, the best percentage of successful results was obtained from the Folk trees. These are splendid sturdy specimens, and should be used again if this work is continued. The Minturn tree is also a fine individual, and although the results thus far have been discouraging, the experimentation with it has been too limited to have any decisive value.

Self Sterility in the Chestnut.—For a long time it has been common knowledge that isolated chestnut trees bear no fruit, or, at most, only a few nuts. Large crops of burs may be produced, but the nuts inside the burs contain no "meats" or embryos. At the present time both the Smith tree and the Minturn tree, of the Oyster Bay region, bear only a few sound nuts each year. Mr. Smith reported that in September of last year (1931) about eight bushels of burs were raked up from the ground, which contained only empty shells of nuts. However, a few had sound nuts, and these—about 50 in all—he kindly saved for us. Some of them were sent to the U. S. Department of Agriculture, and the rest have been planted in our greenhouses for comparison of their seedling stages with those of the bagged nuts secured from the same tree. Mr. Smith tells us that formerly the tree bore large crops of good nuts. When one considers the large numbers of healthy American chestnut trees which, before the advent of the blight, flourished in the woods nearby, it seems a well warranted conclusion that their pollen, carried by the wind or by insects to Mr. Smith's Japanese tree, was the essential factor in its fertility. The same condition of affairs, although to a lesser degree, is true of the Minturn tree. Formerly it bore fair crops of nuts. The native chestnut trees were here obviously not so close at hand. In the Hammond tree one of the leaders is a graft, which differs from the other leader (the original stock) in size of leaves, burs, number of nuts in the bur, to a slight extent in the time of flowering, and also in other characters. We have here what amounts essentially to two different trees, therefore, and natural cross-pollination occurs. The yield of nuts each year is good. What was said of the Smith tree applies also to the Winthrop tree—now an isolated individual. It is a most significant fact both from the standpoint of sterility and, on the other hand, in favor of the success of our pollination work, that the *only* nuts developed on this tree during the past two

years—and these have been fine specimens—have been formed in the burs pollinated by us. In the case of the Folk trees, several individuals are growing in fairly close proximity, and consequently splendid yields of nuts are the result.

Dr. A. B. Stout [1] calls the periodicity in the maturation of the staminate and pistillate flowers of the chestnut a case of *duodichogamy*. He says: "In flower behavior, chestnuts exhibit a double dichogamy or a duo-dichogamy. The lower catkins on the flowering branches bear only staminate flowers and these mature first in the season of bloom. The pistillate flowers at the base of younger catkins above are next to bloom, and still later there is maturity of another set of staminate flowers borne on the same catkins with the pistillate flowers. Thus there are for the tree as a whole two end-season periods of pollen-shedding and a mid-period with the maturity of the pistillate flowers."

In Fig. 3 the lower catkins are shedding their crop of pollen. The pistillate flowers are presumably not yet mature, and the later crop of stamens above them is still in bud. To determine whether the pistillate flowers can be fertilized by the first crop of pollen, two flower clusters on the Minturn tree were pollinated, using this pollen, but the results were negative. This experiment will be carried out on a more extensive scale in further work. Pollination with the later crop of pollen should also be tried, as well as the testing of both crops of pollen in the laboratory for viability. The maturation of the two crops of pollen is not always as clear-cut as Fig. 3 would seem to indicate. Examination of the figure with a hand lens will reveal several stamens already out on one of the upper catkins. During late July, in August, and even in September, stray staminate flowers can be found occasionally on the trees. It is possible that such irregularity may be connected with the ripening of a few nuts on the isolated trees.

Seedling Chestnuts Planted in 1931.—Two plantings of seedling chestnuts were made during 1931, on land belonging to the writer at Hamden, Conn., as follows:

1. On April 17, thirty-two seedlings grown in the Garden con-

[1] Stout, A. B. The pollination problem in nut-bearing trees, Rept. of Proc. of 20th Ann. Meeting, Northern Nut Growers Assn., pp. 64–69. 1929.

servatories from nuts obtained from the Folk trees Oct. 6, 1930 and planted Oct. 29, 1930. Of these thirty-two, ten died during the summer, mostly on account of the severe drought. Of the twenty-two remaining, two are nearly two feet high, and some are over one foot. In addition to these Japanese trees, one seedling of the American chestnut was also planted—raised from seed obtained from a chestnut vender on Broadway, New York City, in October, 1930.

2. On April 25, twenty-nine trees, received from the U. S. Department of Agriculture. Some of these are Chinese chestnuts (*C. mollissima*), and three are the S-8, Dr. Van Fleet's hybrid of the Chinese chestnut and the chinquapin. Three of the twenty-nine died during the summer, among them a valuable Japanese hybrid (M-38). The rest are doing well, one of the S-8's having made a growth of sixteen inches.

Altogether, there are now 137 chestnut seedlings of various kinds growing on this land. The trees are planted fifteen feet apart in the row and the rows are fifteen feet apart. Records of the growth and condition of each tree are being kept from year to year. The main purpose of this plantation, which is now commencing its fourth year, is the development of promising stock for hybridizing experiments in the future.

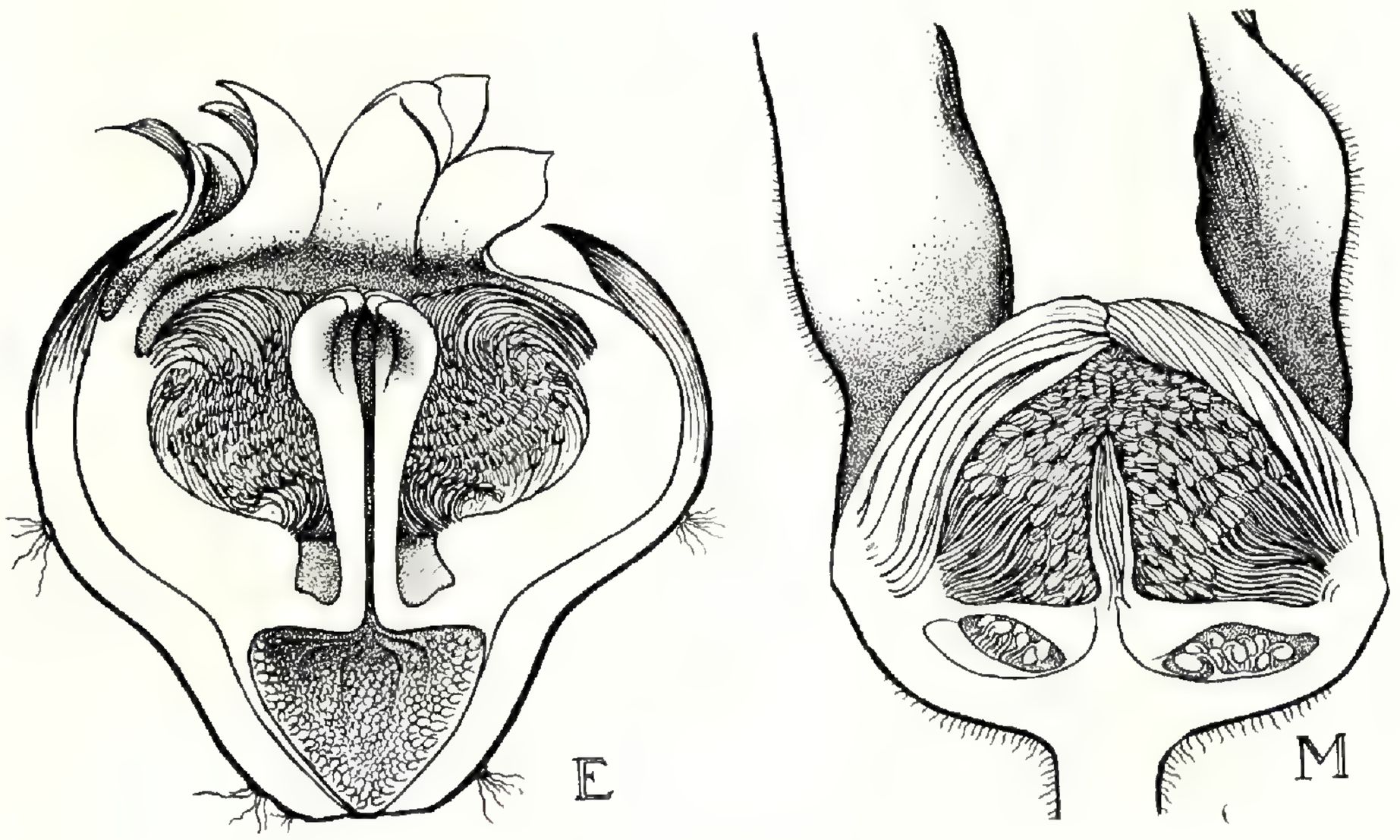

FIG. 4. *Echinocactus Saglionis* (*E*) and *Mesembryanthemum pomeridianum* (*M*). Flower buds in longitudinal section, showing resemblance of many characters.

Beardless Iris Project

By George M. Reed

Many valuable additions to our collection of varieties of Japanese iris have been made. When we were in Japan in 1930 we selected a number of varieties for importation, and these were received during the past year. The new additions to the collection include 27 named varieties from Horikiri-yen, 36 from Kotaka-yen, and 40 from Yoshino-yen, these being the largest and best kept up gardens in the vicinity of Tokyo. Most of the varieties grown in the Kotaka-yen are among the oldest in cultivation, dating back a century or more. A few varieties of a specialized type of Japanese iris known as Ise-shobu were also added to our collection.

The condition of many of the plants on their arrival was very disappointing. They had been long delayed in transit and subjected to other adverse treatments. However, they have grown very well and a few plants even flowered during the season. By careful culture, including abundant watering, all of the varieties have come through, and fully ninety-five per cent. of the total number of plants received.

In addition to the named varieties, several collections of wild

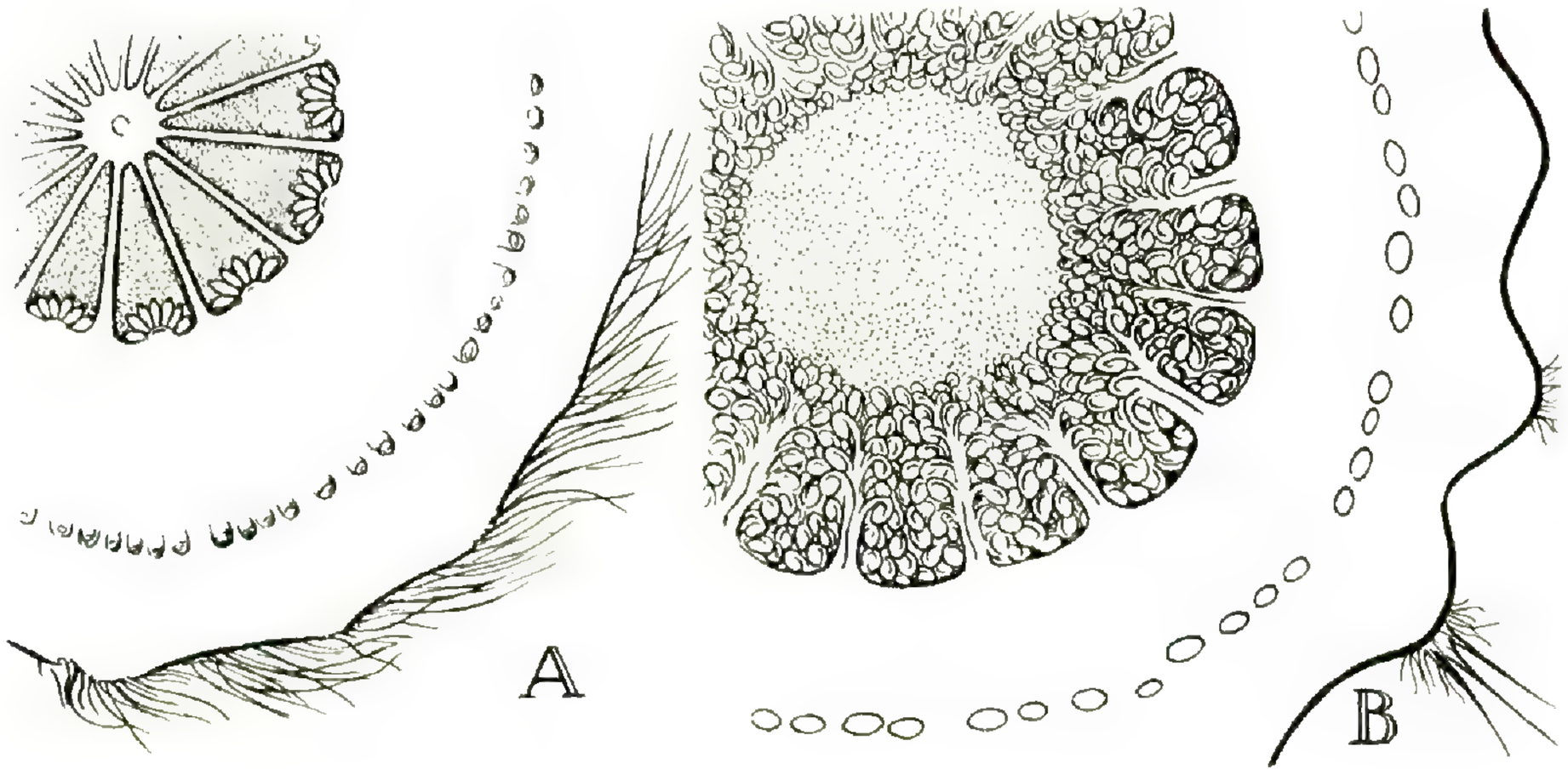

Fig. 5. *Selenicereus* sp. Cross-sections of ovary. *A*, very young, with ovary divided (much magnified); *B*, adult, ovary one-celled (slightly magnified).

forms of *Iris Kaempferi* collected in different parts of Japan were also received. These grew very successfully and most of the clumps flowered, although not in their fully characteristic manner. In another year it will be possible to make comparisons between the flower characteristics of the plants from different localities. A large number of seedlings, both of the wild form as well as the cultivated varieties, are now growing, and a few may be expected to bloom in 1932. All of these came from seeds secured in Japan in 1930.

A large number of crosses between different varieties of Japanese iris were made during the past season. In making the crosses, various characteristics of the individual parents were considered. A very large proportion of the attempts at crossing appeared to be successful. It will of course take two or three years to determine the final results, when the plants obtained come into flower.

We now have nearly 500 varieties in the collection, and the season of 1931 was a successful one from the standpoint of the abundant flowering. Practically all of the varieties bloomed. The varieties had been grouped on the basis of the scheme of classification which had been worked out, and it was possible readily to compare the closely similar kinds. Additional corrections in identification were made, and further descriptions of varieties were written.

In 1929, 75 varieties were introduced from Japan, and these bloomed quite satisfactorily this year. Unfortunately, fully fifty per cent. of them were incorrectly named, the same variety appearing two or three times under different names.

The American Iris Society held its Annual Meeting at the Garden on June 30th, at the time when the Japanese iris were at their height. By far the larger number of varieties were in excellent bloom on the date of the meeting, and it was possible for those who attended to observe the characteristics of the different varieties.

Relatively few plants died during the past season, although in previous years we have lost a large proportion of plants, largely through the fly maggot (*Chactopsis fulvifrons*). Early in the spring the dead leaves were burned over the dormant plants.

Whether this had anything to do with reducing the loss of plants by the fly maggot is perhaps a question. In any case, however, the burning over did no harm to the plants, and greatly decreased the amount of labor in cleaning up in the spring.

In previous years we have had some injury from thrips. During the past season, however, it was unusually severe. This insect enters between the folds of the leaves and penetrates underneath the bracts of the flower cluster. Some varieties seem to be much more susceptible to injury than others, so that practically no well developed blooms were secured; the later varieties appeared to suffer most severely.

Several collections of *Iris lacvigata* were also imported from Japan, and a few of these flowered in June. One variety, the Four Season Iris, bloomed in September and October. Nearly all the plants imported grew very well and became well established, but it remains to be determined how successfully they will withstand our winter conditions. It is hoped, however, that they will survive and continue to multiply and flower in the coming years. These make a valuable addition to our general collection of beardless varieties and species.

The collection of Siberian irises, which now includes about 60 varieties, was well established, and flowered vigorously. Except for the newest productions, we have practically all of the varieties of this group in our collection.

A great many species of beardless iris are now in the collection, most of which flowered during the season. Crosses were attempted between many of them, with what success remains to be determined after the seeds germinate and the seedlings grow to the flowering stage, which will require two to five years.

In July we published a paper on our studies on the hybrids of *Iris fulva* and *I. foliosa*. These two species, the first generation plant—Dorothea K. Williamson—and five seedlings of the latter, were illustrated in color. The second generation seedlings showed marked variation in the shape, size, and color of the flowers. During the past year a large number of additional seedlings from these crosses bloomed for the first time. The plants varied greatly in the length of the stem and the vigor of the plant, as well as in the flower characteristics. It is possible that a few of them may

prove to be excellent garden varieties. For the most part, however, they are interesting in showing the wide variation in the descendants of crosses between *I. fulva* and *I. foliosa*.

Additional watercolor drawings of several species and varieties were made by Miss Louise B. Mansfield; these greatly increase the value of our growing collection of colored drawings. Most of the distinctive types of varieties of *Iris Kaempferi* are now represented. Additional ones, however, will be needed in order to show the differences between the minor groups of these iris.

Many plants of *Iris Kaempferi* were sent in exchange to several people. Based on the requests received, a new interest has been developed in the Japanese iris, and nurserymen and others are desirous of having authentic material. By means of these exchanges we have been able to add mainly to our collection of bearded iris, although some beardless types have also been secured.

The additions to the collection of beardless iris include the following species and varieties received on the basis of exchange: Dr. S. Stillman Berry, Redlands, Cal., 1; Mr. Clement Heaton, West Nyack, N. Y., 1; Mr. L. F. Hoyt, East Aurora, N. Y., 5; Prof. H. Harold Hume, Agricultural Experiment Station, Gainesville, Fla., 5; Mr. Clint McDade, Chattanooga, Tenn., 1; Mrs. Thomas Nesmith, Lowell, Mass., 7; Poughkeepsie Nursery Co., Poughkeepsie, N. Y., 3; Dr. J. K. Small, New York Botanical Garden, N. Y., 23; Southern California Iris Gardens, Pasadena, Cal., 9.

By purchase, 7 species and varieties were obtained from the Yokohama Nursery Co., Ltd., Yokohama, Japan; 27 varieties from the Horikiri-yen, Horikiri, Tokyo, Japan; and 36 varieties from the Kotaka-yen, Horikiri, Tokyo, Japan. We also obtained species and varieties, mostly bulbous and Oncocyclus type, from C. G. Van Tubergen, Ltd., of Haarlem, Holland, and Fr. Vester & Co. of Palestine.

We are greatly indebted to the Yokohama Nursery Co., Ltd., for the care of various wild types collected in Japan. In various localities, plants of different species of iris were collected and forwarded to this Company, where they were planted and cared for until February of the following year, when they were shipped to us. It was quite feasible to dig up plants in the vigorous grow-

ing stage and ship them the relatively short distance to Yokohama, whereas it would have been utterly impossible to forward such plants direct to America. Through the courtesy of the Nursery Company we were able to add very valuable material for the study of the various types of Japanese iris.

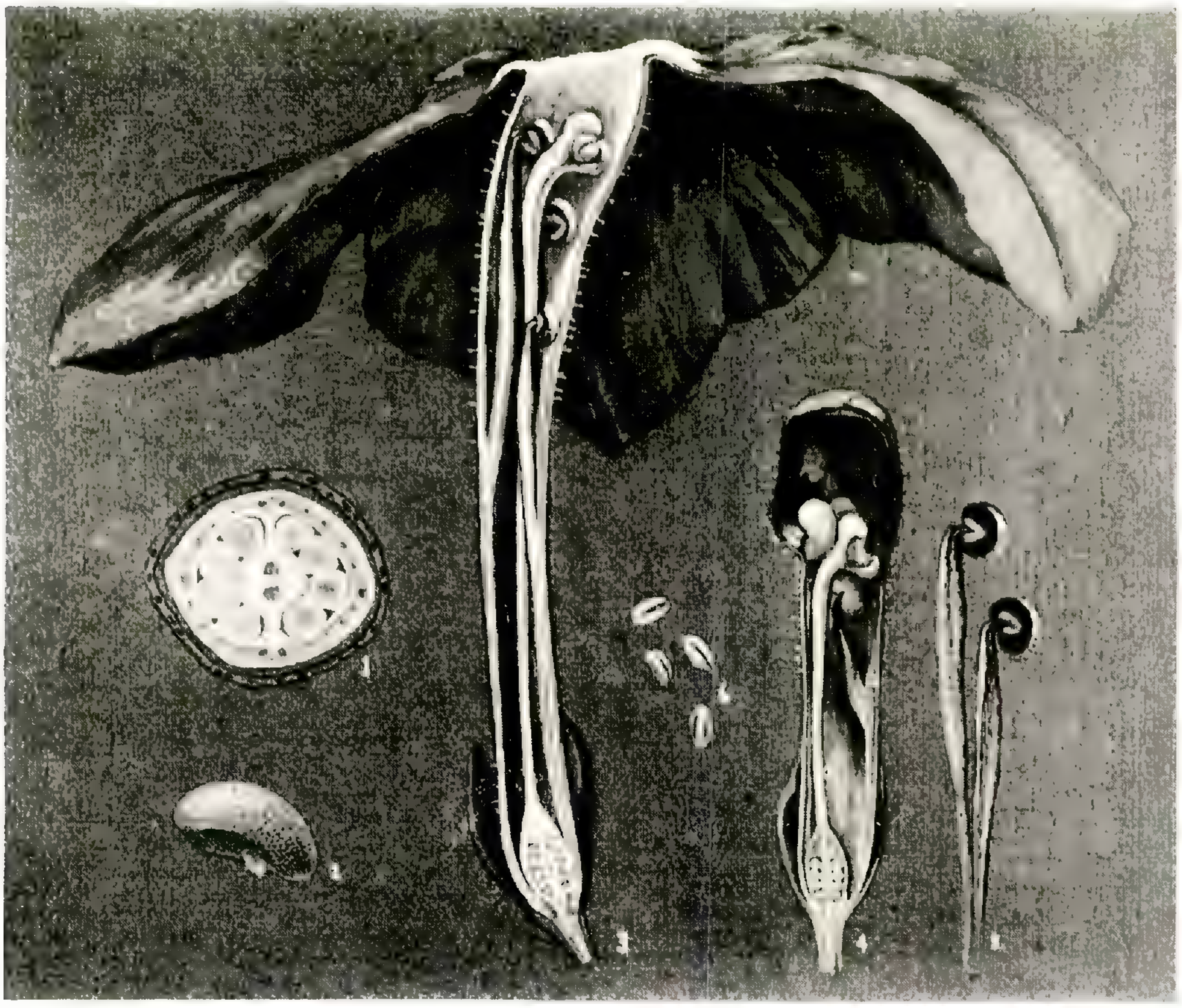

FIG. 6. *Brunfelsia latifolia* (*Solanaceae*). Flower bud and adult flower, showing axile placentation. (7169.)

Systematic Botany

BY ALFRED GUNDERSEN

Flower Buds and Classification of Dicotyledons

The study of flower buds and floral structures was continued during 1931. I have been particularly interested in the families under Engler's *Parietales*. This extensive group doubtless belongs not far from the *Magnolia* group of families, as illustrated

by *Gordonia Alatamaha,* of which we had this fall abundant flowering.

In the Engler system the *Parietales* are followed by the *Opuntiales.* The resemblances between *Cactaceae* (Opuntiales) and *Loasaceae* (Parietales) are very great. In the systems of Bentham and Hooker, and also in those of Warming, Wettstein, Bessey, and Hutchinson, the *Cactaceae* are placed near *Aizoaceae* (Centrospermae or Caryophyllales). Here also the resemblances are very great. The illustration (Fig. 4) shows flower buds from these families. It may be that the *Cactaceae* should be con-

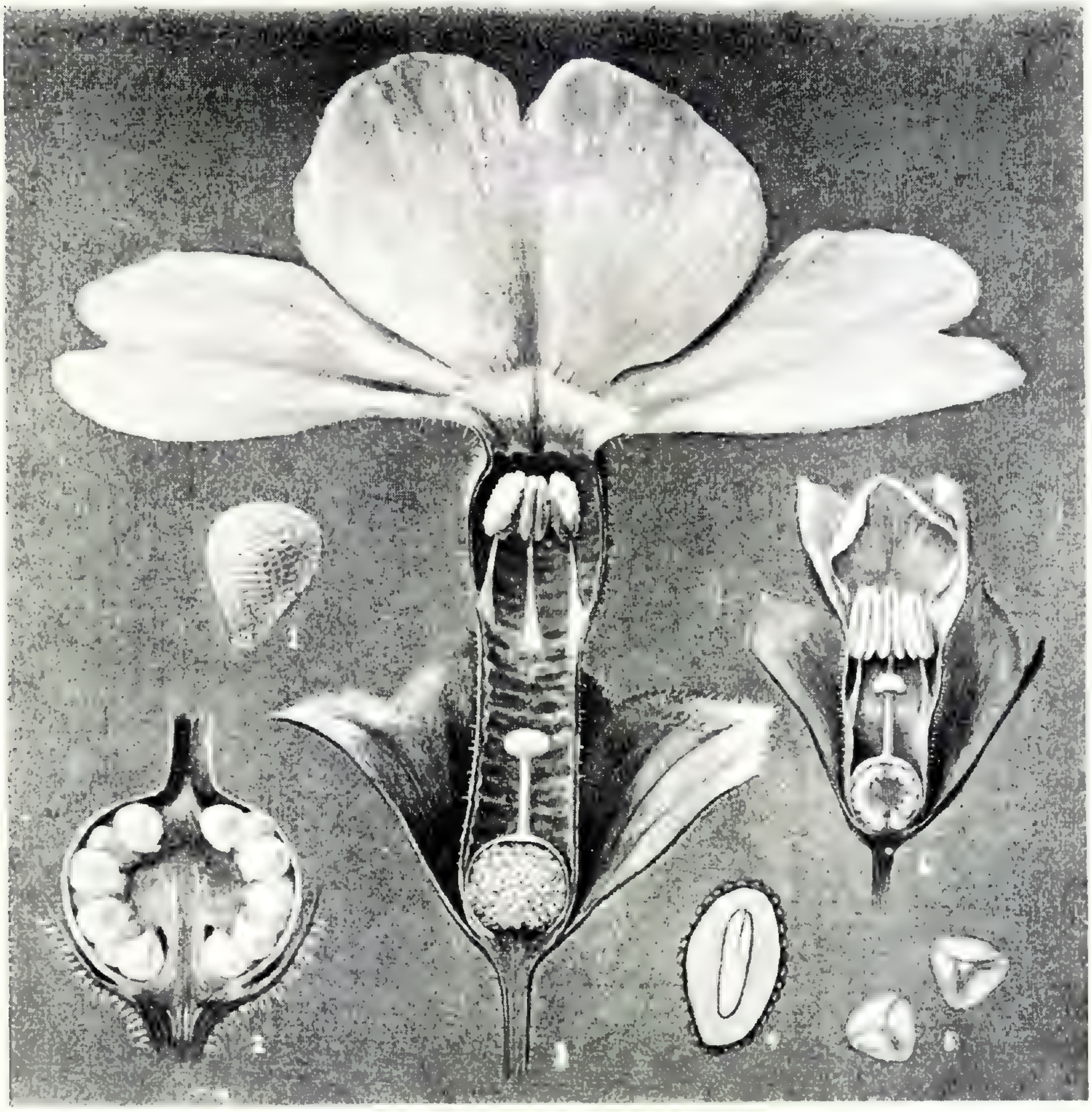

FIG. 7. *Primula obconica.* Flower bud and adult flower, showing central placentation. (7173.)

sidered a link between *Parietales* and *Centrospermae*, the same as *Frankeniaceae* (Parietales).

The second illustration (Fig. 5) shows the sections of bud and adult flower of a *Selenicereus* species with two interesting differences. In the bud the ovary is almost entirely divided, which is approximately the condition in *Aizoaceae*. Again, in the bud the ovules are sessile on the ovary walls, while in the adult they are attached to long branching funiculi. This difference is suggestive, for in the genus *Pereskia*, which by its ordinary leaves appears to be a primitive form of the *Cactaceae*, the ovules are sessile and basal, in this respect like many plants of the *Centrospermae*.

Miss Maud H. Purdy has made a number of drawings and paintings showing details of flower-structures. Figure 6 illustrates the axile placentation of *Solanaceae*, also the relatively large size in the bud of anthers and ovules compared to floral envelopes. In Fig. 7, of *Primula*, the corolla tube is proportionately much shorter in the bud than in the adult flower; the "pearly" ovules and central placentation characterize *Centrospermae* as well as *Primulales*. The early appearance in the bud of the characteristic placentation is of interest.

By Henry K. Svenson

Galapagos Collections

Systematic work of the past year has been largely concerned with determinations and notes on the specimens collected on the Astor Expedition to the Galapagos and Cocos Islands in 1930. I have had the cooperation of numerous specialists in difficult groups and the work is nearing completion.

Eleocharis

A second installment of a monograph of *Eleocharis* has been turned in for publication. Although part of this work was completed before I came to the Brooklyn Botanic Garden, much of the revision has been done here, many specimens having been borrowed for study through the Brooklyn Botanic Garden. The paper is a treatment of a primarily North American group of sedges, known as spike-rushes, which have always been difficult to identify, the group of species centering about *Eleocharis capitata* (*E. tenuis*) being especially discussed.

Genetics

By Ralph C. Benedict

Nephrolepis

Work with the Nephrolepis collection involves two lines of activity: (1) general maintenance of the collection for the interest and value of its status as an assemblage of horticultural and experimental forms; (2) experimental research, looking to further extension of our knowledge regarding these mutable types.

The first problem involves occasional stock-taking, attention to cultural treatment, and the continuance of the accessioned collection in as representative a condition as possible. During the year, a special set of named varieties has been set up as a separate evolution exhibit in House 3; these varieties include examples of the basic forms, the primary sports of the Boston fern, and a few of the extreme lines of development. From time to time requests come in for living collections of these Nephrolepis sports, to be used as instructional material in university work.

During the year an invitation was received to send a representative set of this Nephrolepis material to the forthcoming International Genetics Congress to be held at Ithaca in the summer of 1932. In preparation for this, special spore cultures were started during the summer of 1931, so that both the sporeling and the bud types of variations might be available. In part, some of these will represent experimental cultures not heretofore developed and thus representing new experimental work.

The prosecution of extended experimental work in this Nephrolepis group is a problem of space, research time, and the enlistment of others in some of the varied phases. A beginning along the latter line was made some three years ago when Mr. Louis Eisman began work on the cytology of these forms, working at first at the Botanic Garden and continuing as a graduate student at Columbia University.

Brassica

Experimental work with Brassica has been continued. Some additional types have been grown, including one, the giant tree kale, which has now reached a height of eight feet. A collection of habit photographs, showing the great diversity of form within one cultivated species, has been assembled. Preliminary work in

hybridization has resulted in the production of a considerable F_2 progeny of an interesting cross between the kohlrabi and sprouting broccoli.

Graduate Students and Independent Investigators Enrolled During 1931

Besides the members of the Botanic Garden Staff, several graduate students and independent investigators were engaged in carrying on botanical research in the laboratories of the Garden.

Miss Fanchon Hart completed, during the summer, a thesis, based on the study of some diseases of medicinal plants, for the degree of Master of Arts at New York University.

Mr. Charles A. Finnegan is enrolled at New York University for a master's degree and is basing his thesis on a study of the trees of the Botanic Garden.

Mr. I. H. Ponder has enrolled for two courses in plant pathology at the Botanic Garden. He has undertaken some physiologic studies on the crown rust of oats, and a special problem in a disease of oak trees. He is also enrolled at New York University for the master's degree. He received the Scottish Board of Agriculture Diploma from the College of Agriculture, University of Edinburgh.

Mrs. Marie E. Conklin has undertaken independent investigation on the bacteria which form tubercles on the wild legumes. She is a graduate of Wellesley College and has continued graduate study at the University of Wisconsin.

Miss Elva Lawton is carrying on her investigations on regeneration and polyploidy in ferns. The results will be submitted to the University of Michigan as a thesis for the degree of Doctor of Philosophy. Miss Lawton is an instructor in the Biology Department of Hunter College.

Mrs. Jennie L. S. Simpson, Assistant Professor in the Biology Department of Hunter College, is continuing investigations on the vascular anatomy of Cucurbitaceae. She has received her degree of Doctor of Philosophy at McGill University.

Miss Mollie Sobel, a teacher of biology at Abraham Lincoln High School, is studying for a master's degree at Columbia University, having graduated from Hunter College. She has undertaken a study of the longevity of smut spores as a basis for a thesis.

REPORT OF THE CURATOR OF PUBLIC INSTRUCTION FOR 1931

DR. C. STUART GAGER, DIRECTOR

Sir: I submit herewith my report for the year ending December 31, 1931.

Attendance at the Garden

As shown by the year-end totals at the turnstiles of the five entrance gates, the attendance at the Garden during 1931 was 1,107,039, as against 1,006,027 in 1930. The attendance in the months of January, 48,601, April, 146,664, and November, 76,799, was the largest for those months in the history of the Garden. The largest previous attendance for January—48,309 in 1928—was very close to the figure of 1931. The largest previous figure for April was 115,336 in 1927, and for November 67,842, in 1928. In April, the unusually attractive displays of naturalized crocuses, daffodils, and narcissus, covering acres of the Garden lawns, are probably the principal reason for the large attendance of this month; and the unusually mild weather in November must have been partly accountable for the increase during that period. In connection with the April attendance it is of interest to note that the largest week-end attendance ever recorded occurred on April 18 and 19. On these dates more than 28,000 people came to enjoy the brilliant displays of 25,000 yellow daffodils dancing on the lawns, the handsome pink magnolias in the magnolia triangle, the various kinds of forsythias forming almost solid masses of yellow here and there about the Garden, as well as the great variety of other early-flowering shrubs and herbs. The figures at the turnstiles totalled 28,662, the highest previous record being 20,356, on the corresponding week-end last year, April 19 and 20. On the preceding week-end this year, namely April 11 and 12, the attendance was 19,884. It is very clear that a visit to the Botanic Garden to see the spring flowers is becoming more and more an "institution" among residents of Greater New York.

The combined attendance at the Garden classes and lectures was 123,630, or about the same as that of last year—135,388.

TABLE IV

ATTENDANCE AT GARDEN DURING 1931

	Jan.	Feb.	Mar.	Apr.	May	June	July
At regular classes	1,233	876	936	3,906	3,914	3,600	14,080
At visiting classes	465	322	587	3,316	13,991	4,184	506
At lectures to children	225	210	610	3,225	11,889	4,084	306
At lectures to adults	95	40	0	165	500	265	0
At conservatories	2,577	2,869	5,857	18,411	16,464	10,266	10,874
At grounds	48,601	55,808	65,746	146,664	169,486	125,367	108,470

	Aug.	Sept.	Oct.	Nov.	Dec.	Annual Totals
At regular classes	13,200	9,316	2,771	3,235	3,382	60,449
At visiting classes	0	0	3,162	5,323	1,192	33,048
At lectures to children	0	185	2,222	4,320	1,002	28,278
At lectures to adults	0	250	295	195	50	1,855
At conservatories	8,928	8,183	11,124	11,378	5,895	112,826
At grounds	80,600	97,454	86,622	76,799	45,422	1,107,039

School Service

During the year we received 934 requests for study material from 203 schools of Brooklyn and other boroughs. The latter figure includes 30 high schools and annexes in Brooklyn, 10 in Queens, 13 in Manhattan, and 17 in the other two boroughs; also 20 junior high schools, 9 colleges and universities, 3 training schools for teachers, 80 elementary schools, and 25 private and parochial schools. In addition, 15 other institutions, such as School Nature League (N. Y.), Prospect Heights, St. Johns, and Kings County Hospitals (Brooklyn), and Newport (Rhode Island), Hospital were supplied with plant material. The total number of pupils in all the school classes served is 223,801, as against 196,177 last year. As usual, Miss Rusk has had charge of the distribution to the high schools. The demand for agar for petri dishes for the study of molds and bacteria has been greater than ever, last year 5,482 dishes having been filled—in the month of December alone, 1,355 dishes. The preparation of the nutrient agar and the filling of the dishes are time-consuming operations, and some one to definitely take charge of this part of the work, as well as to help in giving out plant material, is much needed.

FIG. 8. Class from Kings County Hospital, enrolled in the Course for Student Nurses. Early blooming hardy Asters in foreground. November 4. (7322.)

Adult Classes

The total number of students in the adult classes during 1931 was 638, the largest figure for any year in the history of the Garden. The total for 1930 was 485. The largest registration in any one class last year was 99 in the spring course on the flowering plants of Greater New York, Dr. Svenson and Miss Rusk, instructors. This class had to be divided into two sections, one meeting in the morning and one in the afternoon. The class for tree study was also large, 77 registering, and this was also divided into a morning session in charge of Miss Vilkomerson, and an afternoon section, in my charge. Since many of the students wished to take both courses, which were scheduled originally for practically the same hours on Saturday afternoons, it was thus possible for them to take the tree course in the morning and the flower course in the afternoon, or vice versa. The registration for the tree and shrub course was also large in the fall—60 in all—and this again had to be divided into two sections in charge of Miss Vilkomerson and myself.

The class in General Botany was this year again conducted by Miss Rusk. As was stated in the report for 1930, the subject matter of this course is so extensive that it was thought it might have to be lengthened into a two year course. This has been done, commencing with the school year in September, 1931; and consequently this year only the lower plants are being studied, *i.e.* the groups below the seed plants in evolutionary sequence. As stated in the Prospectus for 1931–2, the first half of the course (A), namely the year spent in the study of the seed plants, is not a prerequisite for the second (B). This year the laboratory period for the course has been held on Saturday mornings, and a laboratory fee of $5 has been charged in addition to the $5 fee for the lecture periods.

Classes for Nurses

Classes of nurses in training came from three hospitals, St. Johns (15), Prospect Heights (35), and Kings County (70). These classes were in my charge and consisted of ten exercises of two hours each, both in the spring and in the fall. The course included a series of informal lectures, with demonstrations, on the

structure and functions of the organs of seed plants, with microscopical study in the laboratories. The relations between the plant and animal kingdoms were particularly emphasized. At each exercise, a trip was taken through the plantations or conservatories, not only for the study of the plants used in medicine, but also to acquaint the students with the common flowers.

New Courses in 1931

In the new course entitled "Glimpses of the History of Botany," four lectures were given, as follows:

1. January 30. *Pre-Linnean Botanists.* Dr. Alfred Gundersen.
2. February 6. *Some Early Plant Anatomists and Physiologists.* Dr. Arthur H. Graves.
3. February 13. *Early Botanical Exploration in North America.* Dr. H. K. Svenson.
4. February 20. *Modern Trends in Systematic Botany.* Dr. H. K. Svenson.

The course in "Ornamental Shrubs," conducted by Dr. Gundersen, was a new feature this year, and proved popular. A course of this sort has long been needed.

Through the cooperation of the Membership Committee of the Woman's Auxiliary of the Garden, a class in Advanced Gardening was organized, meeting Thursday mornings at 11, beginning October 22. The course presupposes a knowledge of the elements of gardening, such as is presented in the short popular spring and fall courses conducted by Mr. Free. The number registered in this course is evidence that it was needed.

Cooperative Agreement With Long Island University

Through an agreement made in January, 1931, with Long Island University, undergraduate credit for completion of the teachers' or "B" courses given at the Garden will be allowed toward the fulfillment of the requirements for a university degree, provided the admission requirements at Long Island University and the laboratory requirements at the Garden have been fulfilled.

Lectures for High School Students

To supplement biology studies in the High Schools and Junior High Schools of Brooklyn and of nearby points in other boroughs,

the Garden arranged a series of lectures given in the spring in the auditorium of the Laboratory Building. A preliminary list of subjects for the lectures was first sent to every high school and junior high school of Brooklyn, with a request that others be added if desired. The subjects finally chosen were those for which the demand was greatest, and the dates when the lectures were given, as well as their sequence, were also determined as nearly as possible in accordance with the questionnaire. At two of the lectures the auditorium, seating 570, was nearly filled. The lectures were held at 4:10 p.m., closing promptly at 5:00 p.m. Following is the schedule:

March 19.	Reproduction in the Flowering Plants.	Miss Rusk
April 23.	Forestry.	Dr. Graves
May 7.	Types of Plant Nutrition.	Dr. Graves
May 14.	Plant Breeding.	Dr. Benedict
May 21.	The Growth of the Idea of Evolution.	Dr. Benedict

At a later date, Dr. Benedict repeated the last lecture at the John Adams High School, which is so distant that it is practically impossible for the pupils to reach the Garden in time. The attendance was 200, making a total attendance of 1700 for the entire course.

At each lecture, blank cards were distributed to each pupil with the request that he write his name and that of his school and hand the card to one of the attendants when the lecture was over. In this way we learned that representatives from nine high schools and four junior high schools attended at least one of the lectures.

Exhibits

1. *Exhibit for Teachers.*—In response to a request from Mr. Eugene A. Colligan, Associate Superintendent of New York City Schools, the Brooklyn Botanic Garden (as well as other public institutions in New York City) installed an exhibit in the Education Hall of the American Museum of Natural History, to acquaint the teachers of the New York Public Schools with the facilities for visual instruction available to them. The occasion was a meeting on Friday, September 18, of all teachers assigned to visual instruction in their respective schools, and about 1600 attended.

FIG. 9. Outdoor study of willows. Class from Public School 206, Brooklyn. November 6. (7308.)

In the exhibit installed by the Garden, twelve tables four feet by twelve feet were used, extending in a line nearly the length of the exhibition hall. The children's activities were illustrated by charts, a model of the children's gardens, enlarged photographs, etc. The opportunities for visual instruction available in the Conservatories were illustrated by a series of varieties of the Boston fern, showing their evolution from the original type; by a selection of economic plants; and by some specimens of physiologically remarkable plants, such as the Pitcher Plant, Venus' Fly Trap, Telegraph Plant, and Sensitive Plant. The service to the schools, by which fresh material for study is distributed on request, to teachers of botany or biology, was also represented, as well as the filling of petri dishes with agar for the study of molds and bacteria. Some space was devoted also to the publications of the Garden, and a carrying-case containing slides from the loan lantern-slide collection was also included. At the request of the Museum authorities all exhibits were continued until Monday, September 21.

2. *December Exhibit at the Children's Fair.*—At the request of the Executive Committee of the Children's Science Fair, the Garden prepared a model exhibit for the Fair, which was held at the American Museum of Natural History, December 3 to 9, under the auspices of the School Nature League and the American Institute.

The model was designed to demonstrate conditions necessary for the healthy growth and development of green plants. Since the primary object of the exhibit was to illustrate what school children could do themselves in this field, the experiments were made as simple, and at the same time as instructive, as possible. Mustard was used mainly for the material, for the reason that since it has a small seed with little stored food, the seedlings are thrown on their own resources very early, and must then react to the external conditions of their environment. Lupine was also tried, but was not as satisfactory for quick results, chiefly on account of its large seeds.

Over 34,500 people viewed the exhibit at the American Museum, and after it was brought back to the Garden it was installed in House 4 of the Conservatories, where it was on view for three weeks. At the Garden, blue lupines (sown Nov. 6) were used

for the exhibition plants, since by that time considerable differences due to their varied treatment had had time to develop.

3. *Participation in Ten-Year Plan Exhibit.*—The Brooklyn Botanic Garden took part in the Long Island Ten-Year Plan exhibit held in the Eagle Building, Brooklyn, from October 26 to December 15. Plans for the proposed new Eastern Parkway gate, the North and South Washington Avenue gates, and for the "Overlook" were displayed. Those in charge of the exhibit estimate that about 6000 people came to see it.

4. *Exhibit of Medicinal Plants.*—On October 15 Dr. I. M. Fradkin, Brooklyn Pharmacist, of 512 Van Siclen Avenue, wrote to us stating that he would like to install an exhibit, accredited to the Brooklyn Botanic Garden, of medicinal plants in his store window, using living specimens as far as possible. Although it was late in the season, we were able to supply him with the following: one plant of *Ricinus communis* (castor oil bean), three plants of *Convallaria majalis* (lily-of-the-valley), living specimens of *Atropa Belladonna, Prunus serotina* (wild black cherry), *Chenopodium ambrosioides* (Mexican tea), *Glycyrrhiza glabra* (licorice), *Datura Stramonium* (Jimson weed), *Mentha piperita* (peppermint), *Populus candicans* (balm-of-gilead), *Hamamelis virginiana* (witch-hazel), *Aconitum Napellus* (aconite), *Linum usitatissimum* (flax), *Althaea* sp., *Viburnum Opulus* (cranberry bush), *Juniperus communis* (common juniper), *Cytisus scoparius* (Scotch broom), and *Marrubium vulgare* (horehound).

Flower Days

1931 was the fourth year in which "Flower Days" have been held at the Brooklyn Botanic Garden. The total attendance was 897, or an average of 149 persons per "Day". Such popularity means, among other things, that these occasions have become fixtures in the Garden Calendar. For the success of the social part of the program we are much indebted to Mrs. Glentworth R. Butler, who was in charge of arrangements, and also to members of the Woman's Auxiliary and to the young ladies of the Botanic Garden staff who assisted. The six Days observed were as follows:

Monday, April 6. Crocus Day.
Leader: Miss Hilda Loines, F.R.H.S., Chairman of the Brooklyn Botanic Garden Governing Committee.
Friday, April 17. Daffodil Day.
Leader: Mrs. Wheeler H. Peckham, F.R.H.S., Honorary Curator of Iris and Narcissus Collections, New York Botanical Garden.
Friday, May 1. Rock Garden Day.
Leader: Mr. Clarence Elliott, F.R.H.S., Plant-explorer and Specialist in Alpines.
Monday, June 1. Iris Day.
Leader: Dr. G. M. Reed, Curator of Plant Pathology, Brooklyn Botanic Garden.
Monday, June 15. June Rose Garden Day.
Leader: Mr. J. H. Nicolas, Rose Expert, of Jackson & Perkins Company, Nurserymen, Newark, New York.
Friday, October 9. Fall Rose Garden Day.
Leader: Mr. Montague Free, Horticulturist, Brooklyn Botanic Garden.

Lectures for Officials and Members of the Garden

In January and early February, four illustrated lectures were given by members of the staff who had been abroad during the preceding year. These lectures were held primarily to inform officials and members of the Garden of the results of foreign travel by our staff members. The schedule follows:

Jan. 12. Dr. Svenson. The Galapagos and Cocos Islands.
Jan. 19. Dr. Reed. Irises of Japan.
Jan. 26. Dr. Gundersen. Norway, Sweden, Russia, and Germany.
Feb. 2. Dr. Gager. The botanic gardens of Italy, France, and England.

Editorial Work

I continued to serve on the editorial board of the *American Journal of Botany*, and also as editor of the Plant Section of General Biology for *Biology Abstracts*, and as editor of the Brooklyn Botanic Garden *Contributions*. At a meeting of the Torrey Botanical Club, January 21, 1931, I was elected a member of the Board of Associate Editors of the Bulletin of the Club. During the absence of Mr. George T. Hastings, Editor of *Torreya*, I edited three issues of that periodical, namely the March–April, May–June, and July–August numbers. As editor of the Brooklyn

Botanic Garden *Leaflets,* I am pleased to report that as usual ten numbers have been issued, as follows:

No. 1. House Plants. By Montague Free. April 1.
Nos. 2–3. Important Woody Plants of the Greater New York Region. By Arthur Harmount Graves. April 22.
Nos. 4–5. Important Herbaceous Plants of the Greater New York Region. By Henry K. Svenson. May 27.
No. 6. November in Your Garden. By Montague Free and Arthur H. Graves. Oct. 21.
Nos. 7–9. Forms and Functions of Leaves. By Arthur H. Graves. November 18.
No. 10. December in Your Garden. By Montague Free and Arthur H. Graves. December 2.

Miscellaneous

Rare Woods Sent to Yale.—In 1931 we sent the following specimens to the Yale School of Forestry as additions to the collection of woods there. These trees (in one case a woody climber) were being removed from our plantations for a variety of reasons.

1. Small log of the Silk-Cotton Tree, *Ceiba anfractuosum.*
2. An unidentified woody species.
3. Specimens of the woody climber, *Salacia brunoniana.*
4. Logs of the Oriental Spruce, *Picea orientalis.*
5. Small log of *Acanthopanax ricinifolius.*

Inspection of Plants and Grounds.—During the summer, I visited again the Norway Maple tree of Mr. Warner James of Flatbush. This tree is afflicted with a mysterious disease—not the wilt—which we have not yet been able to diagnose. Among other trips, I might mention in this connection that, in company with our Mr. Free, on April 16, I visited the Brooklyn Hospital, De Kalb Avenue and Ashland Place, and assisted in recommendations for planting the grounds near the new additions.

Publicity.—During the year we sent 21 news releases containing 36 articles about events at the Garden, to the various metropolitan dailies. We received 931 clippings as against 745 last year and 792 for 1929.

FIG. 10. Members of regular nature study class, P.S. 206, Brooklyn, teaching a visiting class from their own school a lesson they have had at the Botanic Garden. (7299.)

Post Card Bulletins.—On February 13, post card bulletins were sent to members announcing the file of nursery and seed catalogs available for reference in the Library. On May 28 notices were sent to each member announcing the distribution of 2000 Chrysanthemum plants and 500 Hardy Asters, and again on September 19, announcing the distribution of a quantity of Bearded Iris.

Docentry.—During the year several Garden Clubs and other organizations, as well as high school classes, were conducted through the Garden and Conservatories by members of this department.

Other Personal Activities.—I served on the Committee of Judges at the Children's Science Fair, Dec. 3–9. Lists of lectures and talks given to schools, clubs, and other organizations, of field trips conducted, and articles published, are given in Appendices I, II, and V.

Research.—The report of research carried on during the year (pp. 46–53) has also been presented.

Respectfully submitted,

ARTHUR HARMOUNT GRAVES,

Curator of Public Instruction.

REPORT OF THE CURATOR OF ELEMENTARY INSTRUCTION FOR 1931

DR. C. STUART GAGER, DIRECTOR.

Sir: I hereby present the annual report for the Department of Elementary Instruction.

Some of our high spots are the following. The attendance at our regular Garden classes has been over 55,000, and the attendance at visiting classes, 60,000. Taking all the phases of our work, we have contacted over 1,000,000 children. The last figure represents our classwork (visiting and regular), conferences, seed distribution, and supply of material to schools. We have reached over 95 per cent of our Brooklyn elementary schools, even though the visiting classwork was affected during the fall by the epidemic of infantile paralysis, when schools were asked for some weeks not to send any classes out from their schools.

In my Report for 1930 I mentioned an experiment we were trying with visiting classes, namely, having a school send the same class to us for a series of weekly lessons. During this year eleven schools sent classes numbering from fifteen to fifty pupils in each for a series of lessons lasting from six to twelve weeks. Of course, this does not represent the total of our visiting classes, only those coming for a series of lessons. The most interesting piece of work we have done with this phase of our visiting classwork has been with one fifth grade class of P. S. 206. The Principal, Mr. Arthur Bowie, has sent this group to us weekly from late October through the term. We have taken up with them the regular nature study work of the grade, doing weekly a piece of work which is carried on throughout the following week by the teacher with her English, spelling, and other subjects. A check class of fifteen pupils was used against the work done with P. S. 206. During this time also two other fifth grade classes visited the class frequently for several periods of three weeks each, the original class bringing the visitors up-to-date in nature study and going on with their work. This experiment proves it is quite possible to choose from the syllabus subjects that may be carried on at the school in such a way that the individual pupil shall receive personal attention.

I have had sixty-four conferences with teachers, these representing work with nearly 400,000 children. These conferences pertain to definite plans for the nature work of a school or the outdoor garden work to go into immediate effect.

The Department has assisted in the starting of more nature rooms in Brooklyn schools, in the setting up of exhibits, and in distributing plant materials to the schools. We have been assisted in this work by volunteers from the Brooklyn Junior League.

Our seed work has increased somewhat this year. Over three-quarters of a million seed packets were sold.

The Saturday morning work with children has gone on as usual. There has been a total registration for the year of 570 children, of which 201 represent registration in the outdoor garden. Of the 201, 62 were new children. This represents about the proportion of new to old children that comes year by year. The rose garden in the children's formal garden was remade and replanted.

In spite of the dry season and the infantile paralysis the garden season was successful. Our crop value dropped somewhat below our usual figures, but the garden was not closed during the time of the epidemic, and no cases appeared among our children. Some lessons were given in flower picking and in flower arrangement and 268 bouquets were arranged and given away by the children. Our garden was kept open a little longer than usual this fall

FIG. 11. Children's Garden. A lesson in thinning. (7269.)

because of the late opening of our public schools. On Saturday, July 18, we held a Parents' Day in the outdoor garden, inviting all the parents to come and see the work. In spite of rain, a gratifying number visited us.

The number of teachers registered for classes in this department alone is 243. This figure represents only those people who are coming for thirty weeks' courses.

We have, as usual, assisted outside organizations such as the Brooklyn Home for Consumptives, the Children's Aid Society, and various others with seeds and advice.

Our largest exhibits were set up at the Children's Science Fair at the American Museum of Natural History and for the "Children's Laboratories" (New Rochelle). An exhibit was also sent to the meeting of the American Association for the Advancement of Science in New Orleans, December 28, 1931–January 3, 1932. An account of this will be given in the next Annual Report.

The Garden, through this Department, presented thirty-three certificates of commendation to those elementary schools in Brooklyn which successfully carried on school gardens throughout the summer. On November 19 the certificates were presented by the director to delegates appointed by the schools.

During the month of March I was in England. The object of this trip was to give a lecture before the School Nature Study Union of Great Britain concerning the work done for children at the Brooklyn Botanic Garden. I wish here to thank you and the Board of Trustees for making it possible for me to have the time to do this work. There were about 200 people at the lecture which was held at the Teachers' Training College of the University of London. During my time abroad I visited a number of the women's schools of horticulture.

I have written, as last year, a weekly article for the New York *Sun*. The *Sun* this year started a regular Garden Page and claims, after a careful survey of their suburban subscribers, that over 33,000 people turn to this Page weekly for help in gardening.

I also wrote another series of short articles on gardening for *McCall's Magazine*.

Besides the time devoted to conferences, I have given considerable time to lecture work. During the year I have given forty-one lectures which have brought us in contact with over 20,000 people. Included in these are four lectures delivered in the interests of the publicity campaign on Long Island under the auspices of the Woman's Auxiliary of the Garden, namely, those given at Shelter Island Heights, Fort Salonga, Forest Hills, and Bay Shore.

There have been no changes in personnel in the Department this year.

FIG. 12. Taking home the product of their own toil from the Children's Garden. If the education is effective the crop will take care of itself. (7344.)

Note may be made here of the distribution of educational material in connection with lectures and classes, both at the Garden and elsewhere. Mention has been made of the amount of living material given out, but no report has been made of the printed and mimeographed sheets of directions and lists of plants prepared and given to individuals in connection with their class work and lectures. The purpose of this distribution is that people may have tangible reminders as a follow-up in the given subjects under discussion. Thousands of these sheets and sets of sheets of printed matter have been given out during 1931 as part of a definite educational plan.

Respectfully submitted,

ELLEN EDDY SHAW,
Curator of Elementary Instruction.

REPORT OF THE CURATOR OF PLANTS FOR 1931

DR. C. STUART GAGER, DIRECTOR.

Sir: I submit herewith my annual report for 1931.

New Plants

Among the plants added to our collections the past year may be mentioned *Stangeria paradoxa* from Natal, South Africa, completing our collection of the genera of cycads. After nearly a year these plants show only slight signs of growth, but they are in good condition. A shipment of rare shrubs was obtained from Hesse, Germany. Many small rare trees and shrubs were obtained from the Boyce Thompson Arboretum. An interesting plant in flower for the first time here was the semi-hardy *Platycarya sinensis*.

Iris Plantations

Dr. Reed, in charge of Iris, reports that "during the past year several varieties of Tall Bearded Iris were added to our collection on the basis of exchange. For the most part, these embraced the newer varieties. We were able to supply a large number of plants of Japanese varieties, as well as a few species of Beardless Iris to California Iris Gardens, Pasadena, Calif., John Lewis

Childs, Inc., Flowerfield, L. I., Mrs. E. F. Emigholz, Cincinnati, Ohio, Mrs. L. F. Hoyt, East Aurora, N. Y., Professor H. Harold Hume, Agricultural Experiment Station, Gainesville, Fla., Robert Wayman, Bayside, L. I., and others. The following varieties of Tall Bearded Iris were received: From Mrs. J. F. Emigholz, Kenwood Iris Gardens, Cincinnati, Ohio, 24 varieties; Mr. Clint. McDade, Chattanooga, Tenn., 17 varieties; American Iris Society, through Mrs. W. H. Peckham, 7 varieties; Southern California Iris Gardens, Pasadena, Cal., 4 varieties; Mr. Robert Wayman, Bayside, L. I., 23 varieties; and Dr. O. E. White, Charlottesville, Va., 3 varieties."

Nursery

The erection of a fence north of the nursery improved conditions for many semi-hardy plants there. It would be desirable to have another fence in order to separate the plants we grow for our garden from those grown for exchange purposes. Among the plants, yet small, growing in the shade north of the fence may be mentioned *Garrya elliptica, Acer circinatum, Acer pennsylvanicum,* and *Libocedrus decurrens.* South of the fence are *Bignonia capreolata, Kadsura japonica, Helwingia japonica, Araucaria imbricata, Cedrus Deodara, Hovenia dulcis,* and many others. *Lagerstroemia indica* was partly killed, but flowered abundantly in the fall.

The nursery was sub-divided into sections and the first accurate maps were made. A list was made of all species in the nursery, frames, and propagating houses, and a part of the duplicates were exchanged.

Students

Mr. C. F. Doney has aided with determinations of shrubs and with the improvement of the maps of the grounds. The improved maps have enabled us to dispense with "service labels" except for temporary use. Miss Sadie Hecht, member of the spring course on Ornamental Shrubs, has studied the collections of *Spiraea* and *Prunus.*

Visits to Other Gardens

In the spring and again in the fall I visited the Arnold Arboretum, where I made somewhat extensive lists of those trees

and shrubs which we do not have and which it is especially desirable that we should have. With Mr. Free, I visited the Hodenpyl estate at Locust Valley, and later the extensive nursery of the Boyce Thompson Arboretum.

Plant Families

With assistance supplied by the Emergency Work Bureau, a preliminary English translation, afterwards typewritten, was made of a large part of the Engler-Gilg *Syllabus,* 9–10 edition. Maps were made of the world distribution of various families.

Nomenclature

In cooperation with Mr. Alfred Rehder, of the Arnold Arboretum, I am preparing a list of species of hardy trees and shrubs, based on Rehder's Manual, indicating the differences in nomenclature in the following publications:

H: Hortus, 1930
K: Kew Hand List of Trees and Shrubs, 1925
R: Rehder's Manual, 1927
S: Standardized Plant Names, 1923
Z: Zander Pflanzennamen, 1927

As an example the differences for the genus *Acer* (maple) are given:

Acer
ambiguum K: *pictum* H R
creticum K Z: *orientale* H R
dasycarpum K S: *saccharinum* H R
laetum Z: *cappadocicum* H R
neglectum K: *Zoeschense* R
obtusatum Z: *Opalus* H R
polymorphum Z: *coriaceum* R
purpurascens K: *diabolicum* H R
striatum Z: *pennsylvanicum* H R
tauricum Z: *hyrcanum* H R
trifidum K: *Buergerianum* H R
ukurunduense K: *caudatum* H R

When these differences in standard publications are extended to the number of genera in cultivation, an idea is obtained of how far

we are from having an international nomenclature for trees and shrubs in cultivation, and of the resulting multiplication of labor in this connection.

Lectures and Classes

In March I gave a lecture on "Pre-Linnaean Botanists," one of four in a course of lectures entitled "Glimpses of Systematic Botany," given by different lecturers. From April to June I had a new outdoor course of eight lessons on "Ornamental Shrubs," in which about a hundred species of shrubs were studied.

Labels and Signs

Labels and signs were made by our labeler, Mr. John McCallum, as follows:

Steel labels for herbaceous beds	550
Steel family labels for beds	28
Lead labels for woody plants	112
Lead labels for conservatory plants	21
Lead labels for rock garden plants	196
Small wooden labels	633
Large wooden labels	63
Wooden signs	65
Cardboard signs	189
Total	1,857

Also numerous miscellaneous numbers and signs.

Dr. Svenson's report on the Native Wild Flower Section, the Herbaceous Beds, and the Herbarium, follows this report.

Statistics

Living Plants Received:

	Species or Varieties	Plants
By exchange	202	290
By gift	137	717
By purchase	431	7,510
By collection	157	414
By loan	1	1
By seed	387	387
Total	1,315	9,319

FIG. 13. Chocolate tree (*Theobroma Cacao*) in flower and fruit. Economic house, December 19. (7384.)

Living Plants Distributed:

To members	6,738
By exchange	91
Total	6,829

Seed Packets Distributed:

By exchange	2,082

Seed Packets Received:

By exchange	1,652
By gift	53
By purchase	57
By collection	176
Total	1,938

Statistics on the herbaria are included in the Report of the Assistant Curator of Plants (pp. 89–90).

Respectfully submitted,

ALFRED GUNDERSEN,
Curator of Plants.

REPORT OF THE ASSISTANT CURATOR OF PLANTS FOR 1931

Systematic Section: Herbaceous Beds

The identity of material in the herbaceous beds is now nearly completely checked, and the two hundred or more additional labels which Mr. McCallum has on hand to be set out in the spring, will do much toward completing our labelling of the beds. Specimens from the rock garden and beds of the difficult genus *Achillea* were sent to Vienna to Dr. Heimerl, the specialist on this group, for verification, a proceeding which I hope can be carried out with other notoriously difficult plants.

The ecological section by the brook (beneath the willow trees) was considerably opened up by the removal of branches which had hitherto obscured the sunlight, and the digging out of *Iris* which had formed a turf throughout the area. The growth of golden club (*Orontium*), cardinal flower, and water hyacinth was very satisfactory during the past season.

Local Flora Section

Dr. Gager, in the Annual Report of the Brooklyn Botanic Garden for 1930, mentioned one of the functions of the garden as "an attempt to preserve a bit of the country in urban surroundings." This is perhaps the keynote of our treatment of the wild-flower garden, which during the past year has been undergoing reconstruction. The beds, which were the feature of this area, have been entirely obliterated and their place has been taken by habitat areas, each designed to represent some outstanding feature of vegetation to be found within one hundred miles of New York. Little has been done in the region of New York to preserve the unique habitats which are required by many species, and as a consequence some of our most interesting wild plants are doomed so far as their growth in the vicinity of a large city is concerned, the chief adverse factors being the cutting of woodlands and the draining of swamps and bogs. The Orchidaceae are especially sensitive to such changes.

The past year has been spent largely in providing the environmental background for the growth of native plants. It has been the intention since the Local Flora Section was started (in 1915) to grow representatives of all the native species of flowering plants and ferns. It is hoped that this section will be opened to the public some time during the year 1932, but construction work and the necessity for newly-planted material to get a good start may perhaps delay the opening. Many undesirable trees and shrubs have already been cut out, but this work must be done with discretion and it will be many years before all the introduced trees and shrubs will have vanished from the section. I am especially indebted to Mr. Free for his whole-hearted cooperation in carrying out plans for grading, planting of trees and shrubs, and amelioration of soil conditions. Our greatest need for the coming year is a limestone wall or ledge, similar, on a small scale, to the brook ledges in the Japanese Garden. The selected site has an excellent shaded northern exposure where it will be possible to grow walking fern, bladder ferns, and a number of the rarer rock ferns of our region, as well as many flowering plants which require optimum soil conditions for their spectacular growth. The total amount needed for this construction is about $550.

Habitats which are more or less completed are as follows:

1. *Woodland Slope.*—The upper end of the section provides a well-drained southward slope which can be kept moist in spots and which should ultimately be utilized as the source of a small brook. It has a fairly good covering of young trees, and will be an ideal slope for the earliest spring vegetation. Some of the planted material has been purchased, but the greater part has been collected. Among these are several enormous clumps of cinnamon fern and some extensive fragments of turf with plants included. We have also scattered a large number of seeds of native plants in the area. During the past year the turf surviving between the trees was plowed under with the contents of several bales of peat. Plantings in this area include 500 specimens of *Trillium grandiflorum,* several hundred hepatica, dog's-tooth violet, spring beauty, Canada May-flower, etc. In the moister part a small grove of red maple (*Acer rubrum*) has been set out; the upper part has been planted with white oak (*Quercus alba*).

2. *Sand Area.*—This habitat includes a small pond and adjacent areas of sand, some of which was transported to the Garden from the central part of Long Island. The species around the pond are mostly late-maturing, the chief plantings being the narrow-leaved goldenrod *Solidago tenuifolia, Coreopsis rosea,* and the handsome *Stachys hyssopifolia.* At the upper margin shrubs have been set out, notably inkberry (*Ilex glabra*), black alder (*Ilex verticillata*), bayberry, wild roses, etc. The adjacent sands have been planted with *Hudsonia,* which up to the present time seems to be doing well, and with other species of plants characteristic of the sand barrens of Long Island and New Jersey. A total of fifty cubic yards of sand was obtained, of which a small portion has been used for the *Arctostaphylos* beds in the systematic collections, and for the margin of the bog; the rest has been used to form the Sand Area.

3. *The Bog.*—The bog was constructed in 1915. Its contents were removed last winter and placed in the Sand Area. After a coating of asphalt, the concrete basin was filled to capacity with peat, and a peat area has also been formed around the borders. The plantings include *Rhodora, Kalmia polifolia, Calla,* and other members of our northern flora, together with a large number of

representatives of the New Jersey pine-barren bogs such as white cedar (*Chamaecyparis thyoides*), pyxie moss, *Polygala lutea,* several species of pipewort (*Eriocaulon*), and *Xyris.* They have lived through the past summer and appear to be prospering. A good growth of *Sphagnum* moss and pitcher plants has been maintained without difficulty and the outlook for a really successful bog is very bright. The trailing arbutus (*Epigaea repens*), ordinarily a difficult plant to grow, has succeeded very well on the borders of this area. Between ninety and a hundred species are now growing in the bog area alone. Most of this material has been collected in the New Jersey pine barrens and from bogs in the Catskill Mts.

4. *The Heath Association.*—The old plantation of mountain laurel (*Kalmia latifolia*) at the extreme southern end has taken a new lease of life since it has had extensive ground treatment with peat and decayed leaves. At the borders within the peat zone several species of blueberries and huckleberries have been planted, and it is our intention to assemble here all the native members of the Heath Family which thrive in dry soil.

Phanerogamic Herbarium

Supervision of work in organizing, mounting, and filing material in the phanerogamic herbarium has taken much of my time during the year; the unusual conditions which have provided us with so much clerical help throughout the year may possibly never come again.

During the past year Miss Belle H. Burr, curatorial assistant from September 27, 1928 to July 31, 1931, resigned. Fortunately, beginning August 1, we were able to fill her place with Mrs. Margaret B. Putz, who has had many years of experience at the Garden.

Due to the cooperation of various charitable organizations in sending us clerical workers (the number has ranged from six to eighteen in the herbarium), we have been able to sort out and mount in the past year most of our stored herbarium collections. Many of these specimens have been untouched for years due to the lack of clerical assistance for such tasks. Our records show that 11,254 herbarium sheets have been mounted during the past year; a very large number of sheets have also been repaired and

cleaned, and a sizeable amount of worthless material has been discarded. The total of 79,450 sheets of flowering plants in the general herbarium and Long Island collection (excluding the ferns and material from the Old World) was shown in a count made during the past year. This total does not include about 4,000 sheets of specimens of trees and shrubs in the Schneider collection. The Old World collection and the *Pteridophyta* will be counted for the next annual report.

We are greatly in need of uniform genus covers with a standard labelling. The present covers are to a large extent makeshifts from other collections, and have in general, outlived their usefulness. It is hoped that these genus covers will be obtained during the coming year. Statistics for the herbarium collections will be found appended to this report.

The Fungus Herbarium has been in curatorial charge of Dr. Reed, as heretofore. As soon as possible curatorial assistance should be provided for the herbarium of Bryophytes and Algae.

Herbarium Accessions and Distribution

Phanerogamic Herbarium

We received from Miss M. V. Worstell one volume of herbarium specimens, which were prepared by Abbie M. Doane, one hundred years ago.

By Gift:		
Mr. Edward A. Behr	1	
Mrs. Glentworth R. Butler	1	
Dr. J. A. Drushel	127	
Dr. C. P. Freeman	485	
Miss E. M. Kittredge	40	
Prof. S. J. Record	110	
Dr. H. K. Svenson	175	939
By Exchange:		
Botanic Garden, Cluj, Roumania	120	
Mr. Derrell Cody	2	
Gray Herbarium, Harvard University	300	
Missouri Botanical Garden	1,199	
New York Botanical Garden	7	1,628

By Purchase:		
C. L. Hitchcock and E. J. Goodman	406	
Miss E. M. Kittredge	174	
Mr. E. C. Leonard	161	741
By Collection:		
Dr. C. Stuart Gager	1	
Dr. H. K. Svenson	647	648
Total		3,956
No. of Specimens Distributed		5,423

Cryptogamic Herbaria

Fungi		527
Other Cryptogams		
By Gift:		
Dr. H. K. Svenson	1	
By Exchange:		
Botanic Garden, Cluj, Roumania	9	
By Purchase:		
Miss E. M. Kittredge	2	
Dr. W. Migula, Eisenach, Germany	100	
Fr. Verdoorn, Utrecht, Holland	100	212
Total		739
No. of Specimens Distributed		51

Classes

As in the previous year field classes in the study of the local vegetation were conducted with the assistance of Miss Rusk. These comprised eight classes on Saturday afternoons in the spring and three Saturday afternoons in the fall. Apparently as a result of the new requirements for science teachers in the New York City schools, the attendance at these classes was increased greatly, the registration for the spring course being over one hundred. The expansion of the city has made it very difficult to reach and return from places of botanical interest in the short time of an afternoon. Some method of transportation avoiding transfers, as by bus, to localities still available on the Palisades of New Jersey is perhaps the solution to this important problem.

FIG. 14. *Sternbergia lutea*, in the Rock Garden. September 18. (7350.)

Seed Exchange

Seeds were collected in New York and vicinity by Dr. H. K. Svenson, Miss H. M. Rusk, Miss Belle Burr, Dr. A. H. Graves, Dr. Alfred Gundersen; in Maine by Dr. C. Stuart Gager; in Oregon and vicinity by Mrs. N. P. Gale; and in Tennessee by Mr. Aaron J. Sharp.

Respectfully submitted,

HENRY K. SVENSON,
Assistant Curator of Plants.

REPORT OF THE HORTICULTURIST AND HEAD GARDNER FOR 1931

DR. C. STUART GAGER, DIRECTOR.

Sir: I have the honor to submit herewith my report for the year ending December 31, 1931.

Personnel

Owing to the unemployment situation, it seemed desirable to keep on the payroll as many as possible of the per diem laborers during the winter 1930–31. Nine men were employed throughout the winter instead of the usual four or five. Because of this, and because of the comparatively open winter, it was possible to accomplish a great deal of long overdue pruning, grading, soil improvement, etc. The per diem force was augmented in April, and averaged about sixteen between April and mid-September. From the latter date until the close of the year eleven men were on the books. The gardening force (nine men) was essentially the same as in 1930.

Labor Paid for by Charitable Organizations

From January 1 to March 10, five men worked for a total of 203 days. Beginning November 23 until December 31, fourteen men worked for a total of 126 days. The above were paid by the Emergency Work and Relief Bureau.

From May 11 to the end of the year, fourteen men worked for a total of 886¾ days. These were paid by the Brooklyn Bureau of Charities.

From April 7 to the end of the year, one man, paid by the Brooklyn Association for Improving the Condition of the Poor, worked 111 days.

General Systematic Section

Following out the plan of representing Orchidales in the Systematic Section, provision was made for hardy orchids by preparing for their reception a position on, and at the base of the border mound opposite the Gramineae. A rocky bank was constructed, half of it made up of acid soil, and half with neutral or slightly alkaline soil. Pipe was laid to supply water which trickles down to a depression in which bog orchids (acid soil) are planted on one side, and swamp orchids (sweet soil) on the other. Three hundred orchids, representing seven species, were planted in the spring.

For many years, the shrubs in the family Oleaceae (Privet, Lilac, Forsythia, etc.) have been so crowded that it was difficult to see individual specimens. In order to make room, the trees and shrubs belonging in the Ebenales (*Diospyros, Halesia, Styrax*) were concentrated near the west walk and the beds for Primulaceae and Plumbaginaceae moved north and east and re-made. The Oleaceae were then extended into the area formerly occupied by these groups. This involved a great deal of work, partly because of the size of the shrubs moved (many were 15 feet in diameter), and partly because an old road was found crossing the area eight or ten inches below the surface. This road varied in thickness from six inches to two or three feet and provided an adequate explanation of the failure to thrive of vegetation planted over it.

In the Ranunculaceae the Peony bed was remade and replanted using, in addition to the species, eight garden varieties with single flowers.

Local Flora Section

The bog was made watertight (we hope) by covering its concrete walls and floor with pitch. This should also serve to prevent the acid peat moss, with which the bog was filled, from becoming neutralized by alkaline seepage from the concrete.

The pool with a sandy bottom and margin was completed and two hundred feet of trench dug and water pipe laid for its water supply.

Log steps were set on the slope at the north end of the garden.

Soil was excavated over an area of sixty square yards which is to be filled in later with sods from a wet meadow.

A car load of Rhododendrons (*R. maximum* and *R. catawbiense*), consisting of 335 plants, was planted, some inside the wild flower garden, but most of them outside the fence to serve as a screen.

Planting carried out in addition is noted in the report of the Assistant Curator of Plants.

Rock Garden

The Rock Garden on the east side of the walk was extended about forty feet to the north. This was done partly because additional room was needed and partly to provide a demonstration in rock garden construction for the class taking the Advanced Course in Gardening.

We exhibited a few rock plants at the monthly meeting of The Horticultural Society of New York on May 20 and received an "'Award of Commendation,' in recognition of exhibits of intrinsic interest, for *Aethionema coridifolium, Lewisia columbianum,* and *L. oppositifolium,* in bloom."

Rose Garden

The "species" borders were enriched by the addition of about 70 bushes representing 66 new names. Our list of rose species and horticultural derivatives now contains over 200 names. It will be noticed that we do not claim to have this number of distinct species and varieties. Many of these plants have not yet flowered and some were raised from seeds and thus have not yet been determined.

The collection of garden roses was kept up and new varieties tried out in the "novelty" beds. Considerable interest was manifested in the "Green Rose" (*Rosa chinensis viridiflora*) which blossomed in the Rose Garden for the first time this year.

It was a good rose year in spite of the necessity of having to combat mildew rather more than usual. Owing to the mild fall, it was possible to cut good rose blooms as late as the early part of December.

Boulder Hill

As mentioned in my report for 1930, over 400 square yards of ground were prepared for Rhododendrons. In the spring, additional beds were made, bringing the total area to be planted up to over 500 square yards. With the exception of a few purchased bushes of *Rhododendron catawbiense* sufficient material for furnishing this area was obtained by replanting and spreading our Rhododendrons that were set out in 1919.

Japanese Garden

The slope west of the White Pine grove, which was in a very rough condition, was regraded and seeded to lawn grasses.

The hill above the upper waterfall was raised and regraded under the direction of Miss Averill.

About 2000 plants of *Pachysandra terminalis,* obtained by division of stock on the grounds, were set out to form a ground cover under the shrubbery inside the tea house entrance.

Ornamental Planting

Nearly two hundred Peonies in 70 varieties were planted in the Conservatory Garden. Four large *Ilex crenata* were moved from the Border Mound to form part of a mass planting at the south end of the Conservatory Garden.

Two thousand plants of Bluets (*Houstonia caerulea*) were planted in the grass around the pool just north of the lower Jenkins Bridge, and amongst the Viburnums. These gave a satisfactory display in the spring but it remains to be seen whether they will be a permanent success.

Twenty flowering trees and shrubs (Peach, Hawthorn, Forsythia, Weigela) were planted for training on the woven wood fence of the Japanese Garden.

Thirty trees of the Carmine Crab and thirty of Sargent Crab were planted on the hill east of Cherry Walk.

Miscellaneous

The Schwedler Maples (80 in all) on either side of the Esplanade were fertilized by the "punch hole" system, using a

concentrated commercial fertilizer and liquid manure from our storage tank.

The area between the walk leading to the north Flatbush Avenue gate and the Local Flora Section was graded and made into lawn. Connecting walks of cinders leading to the north entrance of the Local Flora Section were made.

Pipe railing was assembled and erected to protect lawn and planting around seven drinking fountains.

One concrete-and-wood bench was erected and concrete platform made.

Sixty linear feet of woven wood fence was erected at the north

FIG. 15. Green roses (*Rosa chinensis* var. *viridiflora*), from the Rose Garden, September 26. (7378.)

end of the nursery to provide shade and shelter for plants needing this protection.

Two flights of concrete steps 15 feet wide were constructed south of the Esplanade.

The Laboratory Plaza was graded, terrace banks made, and the soil of the planting areas worked over to a depth of eighteen inches. The road leading to the north steps was raised to grade and surfaced with bituminous concrete.

Three tiers of wooden shelves, 2′ 6″ wide, were made around two sides of the new bulb storage room.

Seed and Plant Distribution

In connection with the International Seed Exchange, 2082 packets of seeds were distributed to foreign and domestic botanic gardens and to other institutions and individuals during the spring of 1931.

Surplus plants were distributed to Botanic Garden members in May (Aster, 434; Chrysanthemum, 2170) and September (Iris, 3950), a total of 6554 plants.

We also supplied plants to the following public institutions:

Brooklyn Public Library (Flatbush Branch)—Hardy Perennials, 85

New York Aquarium—Conservatory plants, 75

Brooklyn State Hospital (Creedmoor Division)—Conservatory plants, 24

The Brooklyn Hospital—Trees and shrubs, 101

Personal Activities

I conducted the following "Courses for the General Public" at the Botanic Garden:

Plants in the Home: five talks with demonstration.

Gardening in the Fall: five lessons.

I also took charge in the fall and winter, of six of the ten periods of the new Advanced Course in Gardening.

I acted as one of the judges for the Federated Garden Clubs of New York State at the International Flower Show, Grand Central Palace, March 16; at the Flower Show of the Metropolitan

Gladiolus Society, Grand Central Palace, August 25; and at the Long Island Flower Show under the auspices of the Second District Federated Garden Clubs of New York State at Garden City, September 16.

I am continuing to serve as the District Secretary for the American Rose Society.

Respectfully submitted,

MONTAGUE FREE,
Horticulturist and Head Gardener.

REPORT OF THE LIBRARIAN FOR 1931

DR. C. STUART GAGER, DIRECTOR.

Sir: I submit the report of the library for the year 1931.

Accessions

The additions to the book collection during the year aggregated 935 volumes and 788 pamphlets, making a total of 16,775 volumes and 12,740 pamphlets now in the library.

Somewhat more than half of the new accessions were received either as gifts or in exchange for our own publications. Special acknowledgement for gifts should be made to Dr. C. E. Moldenke, Plainfield, N. J., for fifteen early botanical textbooks and works on horticulture; to Dr. Albert Lemée, Brest, France, for the third volume in continuation of his valuable "Dictionnaire descriptif et synonymique des genres de plantes phanérogames"; and the Hokkaido Government, Sapporo, Japan, for the final sections of Miyabe and Kudo's "Icones of the essential forest trees of Hokkaido," a beautifully printed work in three folio volumes with eighty-six plates in natural colors and descriptive text in both Japanese and English. The total gifts were 97 volumes, 375 pamphlets and current issues of 118 periodicals and serials. The complete list of donors is given in Appendix 1, pages 119–124.

The exchange of Brooklyn Botanic Garden publications for those of other institutions and societies continues to be one of the chief methods of building up the library collection. Of 937 periodicals and serials received regularly during 1931, 688 came through exchange.

Accessions by purchase totaled 432 volumes and consisted for the most part of books of recent publication and files of botanical serials and periodicals. A number of old botanical works, purchased from the income of special funds, were added to the Pre-Linnean collection. Among them are included good copies of a dozen works dating from the sixteenth century, and one title, the "Hortuli commentarium" of Columella, printed at Rome in 1485, was added to the collection of incunabula.

LIST OF SOME IMPORTANT ACCESSIONS

Books

Alpinus, Prosper. De plantis Aegypti liber . . . Venetiis, F. de Franciscis, 1592. (First edition.)

Apuleius, Lucius Madaurensis. Opera, quae quidem extant, omnia . . . Basle, Henricus Petri, 1560. 5 vols.

Arnoldus de Villa Nova. Dyser tractat helt in von Beraytung der Wein, zu Gesundheit und Nutzbarkeit der Menschen . . . Augspurg, Hainrich Stainer, 1529.

Ascherson, Paul and Graebner, Paul. Synopsis der Mitteleuropäischen Flora. V. 1–6, pts. of V. 7 and 12, 1896–1931. (In progress.)

Bauhin, Caspar. Theatri botanici sive historiae plantarum ex veterum et recentiorum placitis propriaq. observatione . . . Basle, J. König, 1658. (First edition.)

Boccone, Paulo. Museo di fisica e di experienze variato . . . Venice, Baptista Zuccato, 1697. (Bound with his Museo di Plante rare della Sicilia, Malta, Corsica, Italia, Piemonte, e Germania. Venice, 1697.)

Boerhaave, Hermann. Index alter plantarum quae in horto academico Lugduno-Batavo aluntur. 2 pts. in 1 vol. Lugduni Batavorum, 1720. (First edition. Presentation copy from author to Dr. Isaac Rand, with inscription on title page.)

Brefeld, Oscar. Untersuchungen aus dem Gesammtgebiete der Mykologie. V. 1–15, 1872–1912.

Colonna, Fabio. Minus cognitarum rariorumque nostro coello orientium stirpium ΕΚΦΡΑΣΙC . . . Rome, Jacobo Mascardi, 1616.

Columella, L. J. M. [Hortuli commentarium] [Rome, Bart. Guldinbeck, 1485] (First separate edition.)

Darwin, Erasmus. Phytologia: or the philosophy of agriculture and gardening. Dublin, P. Byrne, 1800.

Dodoens, Rembert. New herball or historie of plants . . . tr. out of French into English by Henrie Lyte, Esquier. London, Edm. Bollifant, 1595. (Third edition in English.)

Dorstenius, Theodericus. Botanicon . . . Francoforti, Egenolphus, 1540. (First edition.)

Duhamel du Monceau, H. L. Traité des arbres fruitiers . . . Paris, 1768. 2 vols.

Dykes, W. R. Notes on tulip species. London, 1930.

Fuchs, Leonhard. De Historia stirpium commentarii insignes . . . Lugduni, Balthazarem Arnolletum, 1549.

Gärtner, Carl Friedrich. Versuche und Beobachtungen über die Bastarderzeugung im Pflanzenreich. Stuttgart, Hering, 1849.

Gesner, Conradus. De stirpium aliquot nominibus vetustis ac novis . . . epistolae duae. Basel, Episcopius Junior, 1557. (First edition.)

Helmont, Joannis Baptista van. Ortus medicinae . . . Venice, Hertz, 1651. (First folio edition.)

Herbarius latinus. Arnoldus de Nova Villa. Incipit tractatus de virtutibus herbarum. Venetiis, Alexandrum de Bindonis, 1520. (Last edition of the Latin Herbarius, the fifth issued at Venice, and the sixth printed in Italy.)

Herbolario volgare nelquale le virtu della herbe . . . con alcune belle aggiote . . . Venetia, Alexandro de Bindoni, 1522.

[Hortus Sanitatis] Ortus sanitatis. De herbis et plantis . . . anno 1517. [Strassburg, Reinhart Beck]

Humboldt, F. H. A. von. Kosmos. Entwurf einer physischen Weltbeschreibung. 5 vols. Stuttgart, Cotta, 1845–62. (First edition.)

—— and Bonpland, A. Ideen zu einer Geographie der Pflanzen. Tübingen. Cotta, 1807.

Imperialis, Johannes. Musaeum historicum et physicum . . . 2 vols. Venetiis, Giunta, 1640.

Knight, Thomas A. Pomona Herefordiensis . . . London, 1811. (Colored plates.)

Kunth, Karl S. Enumeratio plantarum omnium hucusque cognitarum, secundum familias naturales disposita . . . v. 1–5 and suppl. to v. 1. Stutgardiae et Tubingae, Cotta, 1833–50.

Linné Carl von. Musa Cliffortiana florens Hartecampi 1736 prope Harlemum. Lugduni Batavorum, 1736. (First edition.)

—— Nomenclator botanicus. Lipsiae, Joann. Frider, Junium, 1772.

—— Systeme de la nature trad. Françoise par M. Vanderstegen de Putte. 4 vols. Bruxelles, Chez Lemaire, 1793–1796. (First French edition.)

Locke, John. Observations upon the growth and culture of vines and olives: the production of silk: the preservation of fruits . . . London, Sanby, 1766.

Magnol, Pierre. Hortus regius Monspeliensis . . . Montpellier, Honoré Pech, 1697. (First edition.)

Mattioli, Pierandrea. Commentarii, in libros sex Pedacii Dioscoridis Anazarbei, de medica materia . . . Venetiis, Vincentium Valgrisium, 1554.

Meyen, F. J. F. Neues System der Pflanzen-Physiologie. 3 vols. Berlin, 1837–1839.

Meyer, E. H. F. Geschichte der Botanik. 4 vols. Königsberg, 1854–1857.

Miyabe, Kingo and Kudo, Yushun. Icones of the essential forest trees of Hokkaido. V. 2–3. Hokkaido Government, 1925–1931. (Vol. 1 already in library.)

Munting, Abraham. De vera antiquorum herba Britannica . . . dissertatio historico-medica. Amsterdam, Sweerts, 1681. (Has signature of Joseph Miller, facing title page and book-plate of Society of Apothecaries.)

Parmentier, Antoine A. Mémoire sur les avantages que la province de Languedoc peut retirer ses grains . . . Paris, Didot, jeune, 1786.

Petiver, James. Opera, historiam naturalem spectantia; or, Gazo-phylacium . . . 2 vols. London, John Millan, 1764.

Rauwolf, Leonhardt. Beschreibung der Reyss so er vor dieser zeit gegen Auffgang in die Morgenländer . . . Pts. 1–3, Franckfurt, Raben, 1582. Pt. 4, Laugingen, Reinmichel, 1583. (From the library of Prof. Edward S. Burgess.)

Ray, John. Methodus plantarum emendata et aucta. London, Myntsing, 1733.

—— Stirpium Europaearum extra Britannias nascentium sylloge . . . London, Smith and Walford, 1694. (First edition.)

—— Synopsis methodica stirpium Britannicarum . . . cum indice et virium epitome. London, Smith, 1690. (First edition.)

—— Synopsis methodica stirpium Britannicarum: cum iconibus. 3d edition. London, Innys, 1724.

Sander, Frederick. Reichenbachia: orchids illustrated and described. Series 1–2, 4 vols. St. Albans, Sander, 1888–1894.

Sharrock, Robert. History of the propagation and improvement of vegetables . . . 2d edition. Oxford, W. Hall, 1672.

Tabernaemontanus, J. T. New vollkommenlich Kräuter-Buch . . . Basel, König und Brandmyllern, 1687.

Tournefort, J. P. de. Compleat herbal; or, the Botanical institutions . . . London, 1719–30. 2 vols.

Turner, Dawson. Muscologiae Hibernicea Spicilegium. Yermuthae, Londoni, White, 1804. (Presentation copy, "From the author" on title page.)

Periodicals

L'Agronomie coloniale. Bulletin mensuel de l'Institut national d'agronomie coloniale. Paris. Nos. 19–167, 1918–1931.

Annals of horticulture. V. 1–5, 1846–50. (All published.)

Le Chrysanthème: journal de la Société française des chrysanthemistes. Lyon. V. 1–18, 1896–1914. (From the library of Charles Harman Payne.)

Eugenics Review. V. 2–22, 1910–1931.

Flora and Silva. London. V. 1–3, 1903–1905.

Horticultural register, and gardener's magazine. Boston. V. 1–4, 1835–1838. (All published.)

R. Istituto botanico di Roma. Annuario. V. 1–10, 1884–1902.
Jahresbericht über das Gebiet der Pflanzenkrankheiten. V. 1–16, 1898–1913.
Nord-horticole: bulletin mensuel d'arboriculture, de floriculture et de culture potagère. Lille. V. 1–5, 1896–1900. (From the library of Charles Harman Payne, with his bookplate.)
Notarisia. V. 1–5, 1886–1890.
Nuova Notarisia. V. 1–24, 1890–1913.
Nuovo giornale botanico italiano. V. 1–25, 1869–1893. New series. V. 1–19, 1894–1912.
Revue chrysanthémiste: organ mensuel de l'association française des amateurs et jardiniers chrysanthémistes. Paris. V. 1–7, 1908–1914. (From the library of Charles Harman Payne, with his bookplate.)
Société française d'horticulture de Londres. Bulletin. 1890–1910. (From the library of Charles Harman Payne, with his bookplate.)
La Tribune horticole. V. 1–9, 1906–1914.

Autograph Letters and Portraits

Sixteen letters have been added to the autograph collection. One of the most interesting was written by Robert Brown (1773–1858) to Mr. Shepherd of the Liverpool Botanic Garden, dated November 14, 1811, informing the latter that a microscope has been sent to him. The price of the microscope is four guineas, but there will be nothing due because he finds that an overcharge of that amount was made on some works of Persoon previously sent. A letter from Charles Mirbel, Director of the Jardin des Plantes, dated 1839 and addressed to the Berlin Botanic Garden, requests certain plants for the rose garden at Paris. There is also one, dated 1840, by Joseph Decaisne who succeeded Mirbel at the Jardin des Plantes. A letter dated 1850 and written by James de Carle Sowerby, one of the founders and secretary of the Royal Botanic Society, expresses the hope that the person addressed will decide to join the society, and if much in town, "will be pleased and also afford pleasure to your friends, especially such as residing in town find a garden a healthful resort."

For a number of years the library has been gathering a collection of portraits of botanists, both living and deceased. The collection consists largely of actual photographs rather than prints, and they have been acquired for the most part by gift. Such a collection has great interest in connection with the history of botany and will become increasingly valuable. It is drawn on frequently for lec-

tures and for illustrating the publications of the Garden as well as filling requests coming from publishers and others who are seeking copies for reproduction. Portraits received as gifts during 1931 are acknowledged in Appendix 1, page 124.

Use of the Library

There has been a noticeable increase in the public use of the library, especially by owners of private gardens and by teachers and students from the botany departments of local colleges. As usual, there were many requests for illustrations and descriptions of particular plants, or directions for their culture.

The following are some other special subjects studied, given in the order in which they were recorded from day to day: Iris paintings by Korin, longevity of seeds, medicinal use of herbs in olden times, spraying apple trees, chestnut blight, national program of forestry, diseases of asters, illustrations of pollen grains, "nature printing," miniature gardens, cold frames, white pine blister rust, gardening on a small country estate, edible mushrooms, eradication of poison ivy, Spencer as a biologist, views of the Alps showing vegetation, cross-pollination, wild flower gardening, color of hydrangeas with relation to soil acidity, chemical composition of sweet corn at different periods during storage, natural resources and agriculture of Florida, tung oil industry in Florida, agricultural conditions in North Carolina, plans for laying out a garden of perennials, tree planting in connection with the George Washington bicentennial, scientific names and history of the "York" and "Lancaster" roses as mentioned in Shakespeare, internal structure (longitudinal section) of the seed capsule of *Paris quadrifolia*.

A lawyer secured information from library books regarding the propagation of willows by means of cuttings, for use in a law-suit. A teacher wished the names of flowers which bloom in July, for use in a play she was writing. A director of a Y. M. C. A in New Jersey came several times for advice regarding planting of wild flowers on a tract of land to be used as a summer camp. A list of references on the vegetation of the Sargasso Sea was compiled for the library of another institution.

A lady who has been making frequent use of our early herbals

has given the following outline of her problem: "The plant drawings on which I am working illustrate the botanical (or rather pharmacological) section of an unpublished manuscript, which no one has yet succeeded in reading, as it is written in an unknown cipher, but which has been attributed to Roger Bacon; whether rightly or wrongly is not yet known. In any case, the manuscript appears to record the scientific work of some mediaeval investigator; and is believed by some scholars to have been written about the end of the 13th century, and to contain matter which, if it can be deciphered, may provide important data for the history of medicine, astronomy and, possibly, embryology. A professor in one of our universities has some hope of solving the problem if he can obtain a clue to the cipher through the names of the plants depicted, and has asked me to identify for him as many species as possible. Your fine collection of old herbals has already enabled me to verify two of my guesses (*Hyoscyamus albus* and *Atropa Belladonna*), and I am hoping to be able to come back and verify others next week."

The plant drawings in the old herbals were used at another time by an artist who was preparing designs for making museum models illustrating the evolution of common vegetables since the sixteenth century, and by still another artist (Miss Mansfield) as a basis for style in the preparation of colored illustrations for the magazine *The Country Home,* and black and white illustrations for a new herbal being prepared for publication along lines similar to the old herbals.

Interlibrary Loans

Fifty seven volumes were lent to libraries of the following institutions: Boyce Thompson Institute for Plant Research; California Academy of Sciences; Carnegie Institution of Washington, Department of Genetics, Cold Spring Harbor, N. Y.; Chemical Foundation, New York; Columbia University; General Milk Company, New York; Metropolitan Life Insurance Company; New Jersey Zinc Company, New York; University of Pennsylvania; Rockefeller Institute for Medical Research.

Thirty-five volumes were borrowed for the use of the Garden

staff from the Brooklyn Museum Library, Brooklyn Public Library, and the Library of the United States Department of Agriculture.

The statistical report follows.

Respectfully submitted,

CALVIN W. FOSS,
Librarian.

STATISTICAL REPORT ON THE LIBRARY

Accessions

	Volumes	Pamphlets	Parts (Including Periodicals)
Exchange	63	107	3,823
Gift	97	375	1,476
Publication	0	130	76
Purchase	432	176	1,105
By binding	343	0	0
Total	935	788	6,480

Total number of volumes in library, December 31, 1930	15,851
Number of volumes added during 1931	935
Number of volumes discarded during 1931 (duplicates)	11
Total number of volumes in library, December 31, 1931	16,775
Total number of pamphlets in library, December 31, 1930	11,952
Number of pamphlets added during 1931	788
Total number of pamphlets in library, December 31, 1931	12,740
Total number of volumes and pamphlets in library, December 31, 1930	27,803
Net increase of volumes and pamphlets during 1931	1,712
Total number of volumes and pamphlets in library, December 31, 1931	29,515

American Fern Society Collection

Number of volumes, December 31, 1930	22
Number of volumes added during 1931	9
Total number of volumes, December 31, 1931	31
Number of pamphlets, December 31, 1930	28
Number of pamphlets added during 1931	39
Total number of pamphlets, December 31, 1931	67

Serials and Periodicals

(Including only those of which numbers were received in 1931)

Subscription	124
Gift	118
Exchange	688
Publication	7
Total	937

Cataloging

Books, Pamphlets, and Serials cataloged	2,322
Total number of cards typewritten and filed	4,273

Printed Cards

Torrey Botanical Club index cards on file, December 31, 1930	41,154
Filed during 1931	1,424
Total, December 31, 1931	42,578
Index Algarum Universalis cards, December 31, 1930	27,940
Number of cards received during 1931	0
Total Index Algarum Universalis cards, December 31, 1931	27,940
Catalogue en fiches de la Bibliographie Technique et Agricole Tropicale, Institut Colonial de Marseille, December 31, 1930	6,506
Number of cards received during 1931	1,761
Total, December 31, 1931	8,267

Miscellaneous

Number of users of the library	3,890
Books lent to members of staff	1,237
Books lent to other institutions	57
Books borrowed from other institutions	35

REPORT OF THE RESIDENT INVESTIGATOR (FERNS) FOR 1931

DR. C. STUART GAGER, DIRECTOR.

Sir: I herewith submit a report of the various activities in which I have engaged during 1931.

School Service

Work under this heading followed lines similar to those of 1930. As Chairman of the Program Committee of the New York

Association of Biology Teachers, the following speakers were secured for the year of 1931–32: Dr. L. T. Hopkins, Henry C. Sherman, C. C. Little, F. E. Denny, A. F. Kroeber, and W. M. Smallwood. In addition, the arrangements were instituted which lead to a special joint meeting of the Biology Teachers Association and the Torrey Botanical Club at the New York Botanical Garden in December. A series of talks were given which reached a large number of high school teachers and pupils, those relating to the special Botanic Garden high school program and at the American Museum of Natural History being specifically noted in this connection.

A new State Syllabus in General Biology was completed by a committee of which I was a member. The year course in Methods of Teaching Biology given in the Brooklyn Extension Department of Hunter College (later Brooklyn College) was completed, with some further use of the facilities of the Brooklyn Botanic Garden. Some publications along science education lines are noted under another heading. Under my new appointment as Associate Professor in the Department of Biology of Brooklyn College, which began last September, I hope to be able to make still more use of the facilities of the Botanic Garden than heretofore in connection with high school work.

Editorial Work

During 1931, the 21st volume of the *American Fern Journal* was issued, together with a special supplement describing the project for greater use of both the Botanic Garden and the American Fern Society fern libraries. This supplement, which included the statement of Agreement between the Botanic Garden and the American Fern Society, published also the lists of fern titles in both libraries. Through the use of the loan privileges offered by the Garden, the Editors of the *Fern Journal* hope to promote considerably the informed study of American ferns, and through this measure to increase both the quality and the extent of the *Fern Journal* contributions.

Conservation of Native Plants

Continuance of this work has been accomplished through correspondence, through the distribution of special literature, the

collection of photographs, and the further cultivation of the hart's tongue fern. Plans are under way for a special field meeting during 1932 to be held with headquarters in central New York, with a special survey of present conditions at the hart's tongue natural habitats as one chief object.

Respectfully submitted,

RALPH C. BENEDICT,
Resident Investigator (Ferns).

FINANCIAL STATEMENT FOR 1931

I. Tax Budget Accounts

1530 *Personal Service: (Regular Employees)*
1531 " " *(Temporary Employees)*

Appropriation		$ 82,660.00
Expended		82,660.00

Other Codes than Personal Service:

Code 1532 Fuel Supplies:

Appropriation		$ 4,000.00
Expended	$ 2,700.00	
Transferred to Code 1535, Botanical and Agricultural Supplies	700.00	
Transferred to Code 1541, Repairs and Replacements	600.00	$ 4,000.00

Code 1533 Office Supplies:

Appropriation		$ 600.00
Expended		600.00

Code 1534 Laundry, Cleaning and Disinfecting Supplies:

Appropriation		$ 130.00
Expended		130.00

Code 1535 Botanical and Agricultural Supplies:

Appropriation	$ 2,250.00	
Transferred from Code 1532, Fuel Supplies	700.00	$ 2,950.00
Expended		2,950.00

Code 1536 General Plant Supplies:

Appropriation		$ 450.00
Expended		450.00

Code 1537	Wearing Apparel:		
	Appropriation		$ 50.00
	Expended		50.00
Code 1538	Office Equipment:		
	Appropriation		$ 150.00
	Expended		150.00
Code 1539	General Plant Equipment:		
	Appropriation		$ 1,750.00
	Expended		1,750.00
Code 1540	General Plant Materials:		
	Appropriation		$ 1,750.00
	Expended		1,750.00
Code 1541	Repairs and Replacements:		
	Appropriation	$ 5,775.00	
	Transferred from Code 1532, Fuel Supplies	600.00	$ 6,375.00
	Expended		6,375.00
Code 1542	Light, Heat and Power:		
	Appropriation		$ 500.00
	Expended		500.00
Code 1543	Telephone Service:		
	Appropriation		$ 375.00
	Expended		375.00
Code 1544	Carfares:		
	Appropriation		$ 60.00
	Expended		60.00
Code 1545	Expressage and Deliveries:		
	Appropriation		$ 300.00
	Expended		300.00
Code 1546	General Plant Service:		
	Appropriation		$ 500.00
	Expended		500.00
Code 1547	Contingencies:		
	Appropriation		$ 100.00
	Expended		100.00

Summary of Tax Budget Accounts:

Appropriated	
Personal Service	$ 82,660.00
Other Codes	18,740.00
Total	$101,400.00
Expended	101,400.00

II. Private Funds Accounts

1. *Endowment Fund* ($50,500.00) *Restricted * in Part:*

Income Account:		
Income 1931		$ 2,777.48
Transferred to Endowment Increment Fund	$ 277.75	
Transferred to Special Contributions	2,499.73	2,777.48
		$ 0.00

2. *Life Membership Fund* ($6,500.00) *Restricted:*

Income Account:		
Income 1931		$ 357.48
Transferred to Endowment Increment Fund	$ 35.75	
Transferred to Annual Membership Account	321.73	357.48
		$ 0.00

3. *George C. Brackett Library Fund* ($500.00) *Restricted:*

Income Account:		
Balance, January 1, 1931	$ 12.00	
Income 1931	27.48	$ 39.48
Expended	$ 36.73	
Transferred to Endowment Increment Fund	2.75	39.48
		$ 0.00

4. *Benjamin Stuart Gager Memorial Fund* ($13,417.20) *Restricted:*

Income Account		
Income, 1931		$ 737.92
Expended	$ 663.98	
Transferred to Endowment Increment Fund	73.79	737.77
Balance, December 31, 1931		$ 0.15

5. *Martha Woodward Stutzer Memorial Fund* ($10,000.00) *Restricted:*

Income Account:		
Balance, January 1, 1931	$ 488.12	
Income 1931	550.00	$ 1,038.12
Expended	$ 797.53	
Transferred to Endowment Increment Fund	55.00	852.53
Balance, December 31, 1931		$ 185.59

6. *Mary Bates Spalding Fund* ($2,697.00) *Restricted:*

Income Account:		
Income, 1931		$ 148.32
Expended	$ 116.34	
Transferred to Endowment Increment Fund	14.83	131.17
Balance, December 31, 1931		$ 17.15

* Restricted funds are those limited, by terms of gift, bequest, or solicitation, to the scientific and educational work of the Garden.

7. *Alfred T. White Fund* * ($243,149.27) *Restricted:*

Income Account:		
Balance, January 1, 1931	$ 238.55	
Income 1931	13,373.20	$ 13,611.75
Expended	$ 199.89	
Transferred to Endowment Increment Fund	1,337.32	
Transferred to Special Contributions	12,074.54	13,611.75
		$ 0.00

8. *A. Augustus Healy Bequest* ($9,798.31) *Restricted:*

Income Account:		
Income 1931		$ 538.88
Transferred to Endowment Increment Fund	$ 53.89	
Transferred to Special Contributions	484.99	538.88
		0.000

9. *Robert B. Woodward Bequest* ($25,000.00) *Restricted:*

Income Account:		
Income 1931		$ 1,375.00
Transferred to Endowment Increment Fund	$ 137.50	
Transferred to Special Contributions	1,237.50	1,375.00
		$ 0.00

10. *Alfred T. White Memorial Tablet Fund* ($3,889.85) *Restricted:*

Income Account:		
Income 1931		$ 213.92
Expended	$ 22.00	
Transferred to Endowment Increment Fund	21.39	
Transferred to Special Contributions	170.53	213.92
		$ 0.00

11. *Brooklyn Institute Centennial Fund B. B. G. Share* ($30,000.00) *Restricted:*

Income Account:		
Income 1931		$ 1,650.00
Transferred to Endowment Increment Fund	$ 165.00	
Transferred to Special Contributions	1,485.00	1,650.00
		$ 0.00

12. *John D. Rockefeller, Jr., Fund* ($250,000.00) *Restricted:*

Income Account:		
Balance, January 1, 1931	$ 2,577.32	
Income 1931	13,750.00	$ 16,327.32

* Previously, "Special Account W." Title changed by resolution of the Botanic Garden Governing Committee, December 17, 1931, and the approval of the Chairman of the Finance Committee of the Board of Trustees.

Expended	$ 2,714.63	
Transferred to Endowment Increment Fund	1,375.00	
Transferred to Special Contributions	9,780.00	13,869.63
Balance, December 31, 1931		$ 2,457.69

13. *Citizens Endowment Fund* ($253,929.26) *Restricted:*

Income Account:		
Income 1931		$ 13,966.10
Transferred to Endowment Increment Fund	$ 1,396.61	
Transferred to Special Contributions	12,569.49	13,966.10
		$ 0.00

14. *Sustaining Membership. Restricted:*

Received from dues		$ 491.48
Transferred to Annual Membership Account		474.82
Balance, December 31, 1931		$ 16.66

15. *Annual Membership. Restricted:*

Balance, January 1, 1931	$ 1,769.81	
Received from dues 1931	5,420.00	
Transferred from Life Memb. Acct.	321.73	
Transferred from Sustaining Mem. Acct.	474.82	$ 7,986.36
Expended	$ 6,009.96	
Transferred to Special Contributions	1,500.00	7,509.96
Balance, December 31, 1931		$ 476.40

16. *Tuition and Sales. Restricted:*

Balance, January 1, 1931	$ 3,858.09	
Received 1931		
a. Tuitions	3,393.50	
b. Seed Packets	7,799.04	
c. Sales	797.35	
d. Miscellaneous	29.50	$ 15,877.48
Expended	$ 7,771.90	
Transferred to Endowment Increment Fund	937.98	
Transferred to Special Contributions	2,510.00	11,219.88
Balance, December 31, 1931		$ 4,657.60

17. *Botanic Garden Collections Fund 1931. Restricted:*

Balance, January 1, 1931	$ 153.71	
Received from Contributions	6,762.00	
Miscellaneous	133.26	$ 7,048.97
Expended	$ 6,548.97	
Transferred to Special Contributions	500.00	7,048.97
		$ 0.00

18. *Special Fund (Brooklyn Institute General Endowment Income: Annual Allotment) Restricted:*

Income Account:		
Income 1931		$ 595.00
Transferred to Special Contributions		595.00
		$ 0.00

19. *Cary Library Fund* ($10,000.00—$^1/_5$ *of Income to Brooklyn Botanic Garden) Restricted:*

Balance, January 1, 1931	$ 16.00	
Income Allotment 1931	110.00	$ 126.00
Expended	$ 70.23	
Transferred to Endowment Increment Fund	11.00	81.23
Balance, December 31, 1931		$ 44.77

20. *Henry W. Healy Trust Fund* ($247,421.17—¼ *of Income to Brooklyn Botanic Garden) Restricted:*

Balance, January 1, 1931	$ 472.11	
Income 1931	3,258.31	
Refund	141.60	$ 3,872.02
Expended	$ 343.65	
Transferred to Endowment Increment Fund	325.83	
Transferred to Special Contributions	3,046.19	3,715.67
Balance, December 31, 1931		$ 156.35

21. *Mrs. Henry C. Folger Fund* ($1,000.00) *Restricted:*

Income Account:		
Income 1931	$ 0.00	
Transferred from Special Purposes (Shakespeare Garden)	46.96	$ 46.96
Expended	$ 0.00	
Transferred to Endowment Increment Fund	0.00	0.00
Balance, December 31, 1931		$ 46.96

22. *Special Purposes. Restricted by Terms of Gifts:*

Balance, January 1, 1931	$ 950.14
Received:	
a. Anonymous for Japanese Garden	1,500.00
b. Various for Japanese Iris Test Garden	59.50
c. Special Gifts for Children's Work	5.00
d. Garden Seats	150.00
e. Publishing Colored Illustrations	100.00

f. George Washington Memorial Tree	51.00	
g. Miscellaneous	78.00	$ 2,893.64
Expended	$ 2,241.19	
Transferred to Mrs. Henry C. Folger Fund (Shakespeare Garden)	46.96	2,288.15
Balance, December 31, 1931		$ 605.49

23. *Plant Pathology Research Fund. Restricted:*

Balance, January 1, 1931	$ 3,773.38	
Income 1931	7,523.70	$ 11,297.08
Expended	$ 3,013.05	
Transferred to Special Contributions	7,500.00	10,513.05
Balance, December 31, 1931		$ 784.03

24. *Special Contributions (for 1931 only). Restricted:*

Balance, January 1, 1931	$ 818.02	
Anonymous	1,435.00	
Contributed by Staff to Emergency Unemployment Relief Fund	230.79	
Salary Rebate	200.00	
Miscellaneous	243.64	
Transferred from		
Endowment Fund Income Account	2,499.73	
Alfred T. White Fund Income Account	12,074.54	
A. Augustus Healy Bequest Income Account	484.99	
R. B. Woodward Bequest Income Account	1,237.50	
A. T. White Memorial Tablet Fund Inc. Account	170.53	
Brooklyn Inst. Centennial Fund Inc. Account	1,485.00	
J. D. Rockefeller, Jr., Fund Income Account	9,780.00	
Citizens Endowment Fund Income Account	12,569.49	
Annual Membership Account	1,500.00	
Tuition and Sales	2,510.00	
Collections Fund	500.00	
Special Fund (Inst. General Endowment)	595.00	
Henry W. Healy Trust Fund	3,046.19	
Plant Pathology Research Fund	7,500.00	$ 58,880.42
Expended		58,352.25
Balance, December 31, 1931		$ 528.17

25. *Endowment Increment Fund* ($103,338.40) *Restricted:*

Transferred from other accounts 1931	$ 6,221.39	
Interest 1931	5,198.77	$ 11,420.16
Transferred to Principal		11,420.16
		$ 0.00

Summary of Private Funds Accounts:

Balances, January 1, 1931	$15,174.21	
Income 1931	95,172.22	$110,346.43
Expended	$88,949.26	
Transferred to Endowment Increment Fund Principal	11,420.16	100,369.42
Balances, December 31, 1931		$ 9,977.01

III. Summary of Total Maintenance Budget for 1931

Income

Tax Budget Appropriation 47.9%	$101,400.00	
Private Funds Budget 52.1%	110,346.43	
Total		$211,746.43
Transferred to Endowment Increment Fund Principal		11,420.16
Available		$200,326.27

Expended

Personal Service			
Tax Budget	$82,660.00		
Private Funds	58,352.25		
Total		$141,012.25	
Other than Personal Service			
Tax Budget	$18,740.00		
Private Funds	30,597.01		
Total		$ 49,337.01	$190,349.26
Balance, December 31, 1931			$ 9,977.01

Respectfully submitted,

DANIEL C. DOWNS,
Secretary and Accountant.

Note:—The above "Financial Statement" is a transcript of Brooklyn Botanic Garden accounts in the books of the Treasurer of the Brooklyn Institute of Arts and Sciences. The Treasurer's

accounts are audited annually by a Public Accountant, and a separate audit of this "Financial Statement" is not made in order to save unnecessary expense.

EDWIN P. MAYNARD,
Treasurer.

IV. Tax Notes for Permanent Improvements

N.D.P. 212Q—Completion of improvement of Plaza of Brooklyn Botanic Garden, including construction of underground storage room for tools and bulbs. (Including Architects' Fees.)

Appropriation			$ 21,000.00
Expended	*1930*	*1931*	
Architects' Fees	$ 1,160.79	$ 304.33	
Improvement Work	15,477.20	3,400.00	
Totals	$16,637.99	$ 3,704.33	20,342.32
Balance, December 31, 1931			$ 657.68

N.D.P. 212R—Completion of Metal Stacks in Library Rooms, and Herbarium Cases and mezzanine floor in Herbarium Room, Brooklyn Botanic Garden.

Appropriation			$ 9,425.00
Expended	*1930*	*1931*	
Erecting Stacks	$ 3,454.23	$ 0.00	
New Cabinets, etc.	5,957.00	13.77	
Totals	$ 9,411.23	$ 13.77	$ 9,425.00
			$ 0.00

N.D.P. 212T—General Improvement of Land, lying east of Mt. Prospect Reservoir fronting on Eastern Parkway, including Architects' Fees.

Appropriation ..... $ 24,100.00

No expenditures during the year 1931.

Certified as correct,

EDWARD S. RYAN, *Chief Clerk,*
Department of Parks, Borough of Brooklyn.

APPENDIX 1

GIFTS RECEIVED DURING 1931

Collections Fund

Miss E. Addie Austin
Frank L. Babbott
Edward C. Blum
Mrs. Armin E. Brunn
Mrs. Paul Bucher
Mrs. Glentworth R. Butler
Mrs. William H. Cary
Dugan Brothers
Otto Ebel
Walter Ebel
Miss Adele F. Emerson
Mrs. Lewis W. Francis
John W. Frothingham
Mrs. Herbert F. Gunnison
Clarence L. Hay
Mrs. A. Augustus Healy
Mrs. James M. Hills
Dr. and Mrs. Samuel C. Hooker
William T. Hunter
Mrs. William T. Hunter
Miss C. Julie M. Husson
Edward A. Ingraham
Alfred W. Jenkins
Mrs. Thomas B. Littlejohn
Miss Hilda Loines
Mrs. William W. Marshall
Mrs. Charles E. Perkins
Mrs. James H. Post
Mrs. Charles E. Potts
Mrs. Frederic B. Pratt
Mrs. Nathaniel W. Pratt
William A. Putnam
Mrs. William A. Putnam
Mrs. Frederick W. Rowe
Herbert S. Smith
Mrs. Seth Thayer Stewart
Miss Elise W. Stutzer
Herman Stutzer
Mrs. Herman Stutzer
Supervisor and Teaching Staff, P. S. 18, Brooklyn, N. Y.
Mrs. Adrian Van Sinderen
"C. W."
Miss Frances E. White
Miss Harriet H. White
Miss Abigail Young

Shakespeare Garden

Mrs. Henry C. Folger (for Endowment) . . . . . $ 1,000.00

Japanese Garden

Anonymous $1,500.00

Special Gifts for Children's Work

General Lord Sterling Society C. A. R. . . . . $ 5.00

Garden Seats

Mr. and Mrs. Edward C. Blum . . . . . $ 150.00

Iris Project

Mrs. Wheeler H. Peckham . . . . . $ 79.50

Publishing Colored Illustrations

Woman's Auxiliary, Brooklyn Botanic Garden . . . . . $ 100.00

George Washington Memorial Trees and Tablet

Women of '76 Chapter, National Society of D. A. R. . . . . $ 51.00
N. Y. City Federation of Women's Clubs, Inc. . . . . $ 15.00

Miscellaneous

Woman's Auxiliary of Brooklyn Botanic Garden 63.00
Dr. Nathan T. Beers 25.00

Living Plants

Mr. Ernest F. Archer, about 200 plants of Violets.
The George E. Baldwin Company, 1 *Dendrobium dalhousianum.*
Mr. Herman Becker, 15 *Cypripedium acaule*, 10 *Pedicularis canadensis*, 15 *Epigaea repens*, 15 *Gaultheria procumbens*, 15 *Spiranthes cernua.*
Mrs. D. C. Boyce, 1 *Gentiana acaulis* and 2 *Jacaranda mimosaefolia.*
Mr. John L. Cooper, 50 plants of *Cypripedium*, 6 *Orchis spectabilis* and 6 *Dianthus plumarius.*
The Cottage Gardens Co., Inc., 2 plants of *Thuja.*
Mrs. C. I. DeBevoise, Cronamere Nurseries, 17 species and varieties, mostly Saxifragas.
Mrs. Mortimer J. Fox, 41 mints, etc., for the herb collection.
Miss Margaret Griffin, 21 plants for the wild flower section.
Mr. Clement Heaton, 2 *Adiantum pedatum*, 1 *Gentiana* and 1 clump of *Iris.*
Miss Sadie Hecht, 2 clumps of *Equisetum hyemale.*
Miss Ada James and Mr. Eugene Vivian, 2 *Conopholis americana.*
Kitchewan Nurseries, 121 evergreens in 18 species and varieties.
Mrs. W. H. Koehn, 4 *Primula japonica* Etna Hybrids.
Mrs. C. M. Pratt, 2 *Eriobotrya japonica* and 2 *Annona Cherimola.*
Mr. E. C. Robbins, 5 *Epigaea repens.*
Mr. G. Schretzlaneir, 35 *Lobelia cardinalis.*
Mrs. Aubrey N. Shaw, 1 plant.
Mr. Robert P. Shaw, 5 *Stangeria paradoxa.*
Dr. J. K. Small, 5 *Iris* plants.
Mrs. Walter E. Stoddart, cuttings of *Ampelopsis tricuspidata Lowii.*
Dr. H. K. Svenson, 50 plants of *Cypripedium.*
Miss Isabel H. Tuthill, 45 bulbs of *Narcissus.*
Dr. G. W. Tyrrell, 1 *Bignonia aequinoctialis*, 1 *Vernonia Imperial*, 1 *Gloriosa superba* and 1 *Crinum.*
Mr. L. R. Waldron, 1 package of bulbils of *Dionaea villosa.*

Seeds

The George E. Baldwin Co. (1)
Miss A. Mabel Barrow (1)
Mr. Henry Bird (3)
Miss E. C. Boetticher (1)
Mr. G. W. Dubois (1)
Mr. John Glasser (1)
Miss Margaret Griffin (3)
Mr. Louis Herman (2)
Dr. Duncan S. Johnson (1)
Miss E. M. Kittredge (1)

Paterson, East Side High School Nature Club (19)
Mr. Aaron J. Sharp (10)
Dr. H. K. Svenson (2)
Mr. J. William Thompson (7)
Dr. G. W. Tyrrell (1)
Washington Seed Company (7)

Phanerogamic Herbarium

Mr. Edward A. Behr, 1 specimen.
Mrs. Glentworth R. Butler, 1 specimen.
Dr. J. A. Drushel, 127 specimens.
Dr. C. P. Freeman, 485 specimens.
Miss E. M. Kittredge, 40 specimens.
Dr. J. S. Record, 110 specimens.
Dr. H. K. Svenson, 175 specimens.
Miss M. V. Worstell, 1 book of specimens.

Cryptogamic Herbarium

Dr. H. K. Svenson (1)

Library

Books

Adams, Mr. Henry S., Brooklyn, N. Y. 1
Bartlett, Mrs. L. Hall, Freeport, N. Y. 1
Bishop, Mr. J. Thoburn, Cleveland, Ohio 1
Black, Hon. Loring M., Brooklyn, N. Y. 1
Blatt, Miss Natalie, Brooklyn, N. Y. 1
Brown, Mrs. George Stewart, Brooklyn, N. Y. 1
Carnegie Institution of Washington, Washington, D. C. 1
Chemical Foundation Incorporated, New York, N. Y. 1
Delafield, Mrs. John Ross, New York, N. Y. 5
Dorward, Miss Margaret M., Brooklyn, N. Y. 1
Ericson, Mr. Charles, New York, N. Y. 1
Fedtschenko, Dr. Boris A., Leningrad, U. S. S. R. 2
Forest Experiment Station, Keijyo, Chosen (Korea), Japan 1
Francis, Mrs. Lewis W., Brooklyn, N. Y. 3
Gager, Dr. C. Stuart, Brooklyn, N. Y. 18
Gager, Mrs. C. Stuart, Brooklyn, N. Y. 3
Gluckson, Master Herbert, Brooklyn, N. Y. 1
Gluckson, Master Simeon, Brooklyn, N. Y. 1
Goodman, Mr. Bernard, Brooklyn, N. Y. 1
Graves, Dr. Arthur Harmount, Brooklyn, N. Y. 2
Jones, Miss Helen Swift 1
Kellogg, Mr. George Sawyer, Brooklyn, N. Y. 1
Krafft, Mr. Carl F., Washington, D. C. 1
Lemée, Dr. Albert, Brest, France 1
McIntosh, Dr. Arthur C., Rapid City, S. D. 1
McKinney, Mrs. Ella Porter, Madison, N. J. 1

Missouri Botanical Garden, St. Louis 1
Moldenke, Dr. Charles E., Plainfield, N. J. 15
Mothers' Club of Public School No. 217, Brooklyn, N. Y. 2
Murray, Miss Virginia, Brooklyn, N. Y. 1
New York Board of Education 1
New York Botanical Garden, Bronx Park, N. Y. 4
Oklahoma Forest Service, Oklahoma City, Okla. 1
Onondaga Historical Association, Syracuse, N. Y. 1
Oppenheim, Mrs. William W., Orange, N. J. 3
Parents' Association of Public School No. 217, Brooklyn, N. Y. 1
Porto Rico, Insular Experiment Station, Rio Piedras 1
Public School 89, Brooklyn, N. Y. 1
Rowland, Mr. Dunbar, Jackson, Miss. 1
Shaw, Miss Ellen Eddy, Brooklyn, N. Y. 3
Skransky, Jerome and Norman Ross, Brooklyn, N. Y. 1
Smalley, Master Melvin, Brooklyn, N. Y. 1
Taihoku Government Research Institute, Department of Forestry, Taihoku, Japan 1
R. Orto Botanico della R. Università di Torino, Italy 2
The Tuttle Company, Rutland, Vt. 1
Woman's Auxiliary of the Brooklyn Botanic Garden 3
Women's Benevolent Society of the Marcy Avenue Baptist Church, Brooklyn, N. Y. 4
Zahlbruckner, Dr. Alexander, Vienna, Austria 1

Total 102

PAMPHLETS

American Fern Society 1
American Museum of Natural History, New York, N. Y. 1
Ames, Prof. Oakes, Cambridge, Mass. 3
Arlington Chemical Company, Yonkers, N. Y. 4
Benedict, Dr. Ralph Curtiss, Brooklyn, N. Y. 16
Buxton, Dr. Patrick A., London, England 1
Cameron, Mr. Charles, Tauranga, New Zealand 1
Carano, Prof. E., Rome, Italy 8
Carnegie Institution of Washington, Department of Genetics, Cold Spring Harbor, L. I. 34
Carnegie Institution of Washington, Division of Plant Biology, Washington, D. C. 1
Chodat, Prof. Robert, Geneva, Switzerland 8
Clark, Mr. Harold T., Cleveland, Ohio 2
Compton, Prof. R. H., Cape Town, South Africa 1
Conrad, Dr. C. M., College Park, Md. 3
Darlington, Prof. Henry T., East Lansing, Mich. 2
Dudgeon, Dr. Winfield, Allahabad, India 3

Erlanson, Dr. Eileen Whitehead, Ann Arbor, Mich.	3
Foss, Mr. Calvin W., Brooklyn, N. Y.	1
Fox, Mrs. Mortimer J., New York, N. Y.	1
Gager, Dr. C. Stuart, Brooklyn, N. Y.	121
Graves, Dr. Arthur Harmount, Brooklyn, N. Y.	8
Harper, Dr. Roland M., Tallahassee, Fla.	8
Harvey, Prof. R. B., St. Paul, Minn.	15
Hastie, Mr. C. Norwood, Charleston, S. C.	1
Kay Laboratories, New York, N. Y.	1
Kikuchi, Dr. M., Sapporo, Japan	1
Kohman, Dr. H. A., Pittsburgh, Pa.	2
Levine, Dr. Michael, New York, N. Y.	1
Lind, Mr. J., Viborg, Denmark	2
Linsbauer, Prof. Karl, Gratz, Austria	3
Martin, Mr. Everett P., Flushing, N. Y.	1
Minnesota, Department of Agriculture, Extension Division, St. Paul	1
Moldenke, Dr. Charles E., Plainfield, N. J.	1
Moore, Dr. George T., St. Louis, Mo.	1
Mostovoj, Dr. K. I., New York, N. Y.	2
National Wholesale Druggists Association, New York, N. Y.	1
New York State College of Forestry, Syracuse, N. Y.	2
New York State Museum, Albany, N. Y.	1
Ocfemia, Prof. G. O., Laguna, P. I.	1
Ohio State University, Agricultural Extension Service, Columbus, Ohio	2
Orton, Mrs. W. A., Takoma Park, D. C.	1
Pennsylvania, Department of Forests and Waters, Harrisburg	1
Peters, Mrs. Mary K., Farmingdale, N. Y.	1
Pollard, Mr. Charles L.,	1
Porsild, Dr. Morten P., Disko, Greenland	2
Rand, Dr. Frederick V., Washington, D. C.	2
Redway, Mr. Jacques W., Mount Vernon, N. Y.	1
Reed, Dr. George M., Brooklyn, N. Y.	1
Rich, Dr. Arnold Rice, Baltimore, Md.	1
Rockefeller Institute for Medical Research, New York, N. Y.	9
Rothamsted Experiment Station, Harpenden, Herts, England	6
Staten Island Institute of Arts and Sciences	1
Svenson, Dr. Henry K., Brooklyn, N. Y.	1
Vavilov, Dr. N. I., Leningrad, U. S. S. R.	2
Wroblewski, Dr. Antoine, Kornik, Poland	4
Yale University, School of Forestry, New Haven, Conn.	1
Zillig, Dr. Herman, Berncastel-Cues/Mosel, Germany	2
Total	307

Parts of Publications

(Exclusive of Government Documents)

Agassiz Association, Sound Beach, Conn. 1
American Association for the Advancement of Science, Washington, D. C. 26
American Horticultural Society, Washington, D. C. 3
American Scenic and Historic Preservation Society, New York, N. Y. . . . 3
Argentina, Ministerio de Agricultura, Buenos Aires 3
Benedict, Dr. Ralph Curtiss, Brooklyn, N. Y. 3
British Columbia. Provincial Museum of Natural History, Victoria 1
British Honduras. Conservator of Forests, Belize 2
Burger, Dr. George N., Cincinnati, Ohio 1
Calcutta Royal Botanic Garden, India 1
Canada Forest Service, Ottawa, Ont. 6
Cary, Mrs. William H., Brooklyn, N. Y. 4
City Gardens Club, New York, N. Y. 1
Carnegie Institution of Washington, Department of Genetics, Cold Spring Harbor, L. I. 1
Cattell, Mr. Ware, Woods Hole, Mass. 8
Chichester, Mrs. Emilie P., Brooklyn, N. Y. 1
Cincinnati, University of, Basic Science Research Laboratory 4
Colorado, University of, Boulder, Colo. 2
Committee on the Relation of Electricity to Agriculture, Chicago, Ill. . . . 2
Cuba, Secretaria de Agricultura, Comercio y Trabajo, Havana 6
Dahlia Society of New Jersey, Verona, N. J. 1
Edwards, Mr. Ashley, Montreal, Canada 1
Federation International des Techniciens Agronomes, Rome, Italy 1
Fedtschenko, Dr. Boris A., Leningrad, U. S. S. R. 15
Florida Entomological Society, Gainesville, Fla. 2
Flushing Garden Club, Flushing, L. I. 1
Free, Mr. Montague, Brooklyn, N. Y. 12
Gager, Dr. C. Stuart, Brooklyn, N. Y. 144
Graves, Dr. Arthur Harmount, Brooklyn, N. Y. 3
Hawaii, Board of Commissioners of Agriculture and Forestry, Honolulu 4
Hokkaido Government, Sapporo, Japan 9
Idaho University, School of Forestry, Moscow, Idaho 1
Indiana Conservation Department, Entomology Division, Indianapolis, Ind. 2
Kenya Colony and Protectorate, Forest Department, Africa 1
Loines, Miss Hilda, Brooklyn, N. Y. 37
McFarland Organizations, Harrisburg, Pa. 2
Massachusetts Institute of Technology, Cambridge, Mass. 1
Mathewson, Dr. Chester A., Flushing, N. Y. 59
Medical Society of the County of Kings, Brooklyn, N. Y. 11
Methodist Episcopal Church, Board of Education, Chicago, Ill. 1

Metropolitan Museum of Natural History, Nanking, China	1
Moldenke, Dr. Charles E., Plainfield, N. J.	7
National Plant, Flower and Fruit Guild, New York, N. Y.	3
National Research Council, Washington, D. C.	14
National Research Council of Japan, Tokyo, Japan	2
National Shade Tree Conference	1
New Jersey State Horticultural Society, Trenton, N. J.	1
New York Association of Biology Teachers	1
New York Botanical Garden, Bronx Park, N. Y.	18
New York State College of Forestry, Syracuse, N. Y.	1
New York State Horticultural Society	1
New York State Museum, Albany, N. Y.	1
Northeastern Forest Experiment Station, Amherst, Mass.	1
Orton, Mrs. W. A., Takoma Park, D. C.	1
Pennsylvania, Department of Forests and Waters, Harrisburg	5
Porto Rico, Insular Experiment Station, Rio Piedras	3
Puerto Rico Agricola, San Juan, P. R.	5
Pyle, Mr. Robert, West Grove, Pa.	2
Rathlef, Dr. H. von, Halle, Germany	2
Reed, Dr. George M., Brooklyn, N. Y.	11
Rockefeller Institute for Medical Research, New York, N. Y.	1
Roerich Museum, Himalayan Research Institute, New York, N. Y.	2
Rothamsted Experiment Station, Harpenden, Herts, England	1
Rubel, Dr. E., Zürich, Switzerland	1
Salvador. Ministerio de Agricultura, San Salvador	1
Saunders, Miss Helen, Brooklyn, N. Y.	3
School Garden Association of New York	7
Sociedad Española de Historia Natural, Madrid, Spain	6
Spaulding, Dr. Perley, Amherst, Mass.	1
Struckmann, Mr. Erick, Copenhagen, Denmark	1
Svenson, Dr. Henry K., Brooklyn, N. Y.	1
Taihoku Imperial University, Formosa, Japan	3
Texas Agricultural and Mechanical College, College Station, Texas	1
Tohoku Imperial University, Sendai, Japan	4
Towson Nurseries, Towson, Md.	8
Union College, Schenectady, N. Y.	2
West Virginia University, Morgantown, W. Va.	1
West Virginia University, Scientific Association, Morgantown, W. Va.	1
Wild Flower Preservation Society, Washington, D. C.	2
Yale University, School of Forestry, New Haven, Conn.	9
Zionist Organization, Institute of Agriculture and Natural History, Tel-Aviv, Palestine	4
Total	528

PORTRAITS AND PHOTOGRAPHS

Ames, Prof. Oakes, Cambridge, Mass.	1
Andrews, Prof. F. M., Bloomington, Ind.	3
Arnold Arboretum, Jamaica Plain, Mass.	2
Béguinot, Prof. A., Genoa, Italy	3
Briquet, Dr. John, Geneva, Switzerland	2
Crandall, Mr. E. L., Washington, D. C.	1
Duggar, Dr. B. M., Madison, Wis.	1
Fernald, Prof. M. L., Cambridge, Mass.	1
Gager, Dr. C. Stuart, Brooklyn, N. Y.	1
Griffiths, Dr. David, Washington, D. C.	4
Harrison, Dr. Carrie, Washington, D. C.	29
Harvey, Dr. R. B., St. Paul, Minn.	1
Howe, Dr. Marshall A., New York, N. Y.	1
Jessen, Dr. Knud, Copenhagen, Denmark	1
Jost, Dr. Ludwig, Heidelberg, Germany	1
Lipman, Dr. Charles B., Berkeley, Calif.	1
Maximov, Prof. N. A., Leningrad, U. S. S. R.	1
Moore, Dr. George T., St. Louis, Mo.	1
Orton, Mrs. W. A., Takoma Park, D. C.	1
Seifriz, Dr. William, Philadelphia, Pa.	1
Spoehr, Dr. Herman A., New York, N. Y.	1
Woods, Dr. A. F., Washington, D. C.	1
Total	59

AUTOGRAPH LETTERS

Gager, Dr. C. Stuart, Brooklyn, N. Y.	5
Harrison, Dr. Carrie, Washington, D. C.	1
Miller, Mr. E. S., Wading River, N. Y.	4
Total	10

MAPS

Chichester, Mrs. E. P., Brooklyn, N. Y.	1

For the Department of Elementary Instruction

Balsa-Wood Company, One four-foot balsa log and one small piece of balsa wood.

Bartlett, Mrs. L. Hall, One book for the children's club room library.

Bishop, Mr. J. T., One book for the children's club room library.

Blatt, Miss Natalie, One book and $1.00 for the children's club room library.

Butler, Mrs. Glentworth R., One prize cup competed for by the girls in the outdoor garden.

Coca-Cola Bottling Company, Seven hundred sets of pictures for nature study work with children.

Delafield, Mrs. John R., $5.00 for the children's club room library.

Flatbush Garden League (through Mrs. E. L. Carson), Two prize books for the greatest improvement made by a first year boy and girl in the outdoor garden.
Gager, Mrs. C. Stuart, Three books for the children's club room library.
Garden Class of P. S. 89, $3.00 for the children's club room library.
General Lord Stirling Society, Children of the American Revolution, $5.00 for the children's room.
Gluckson, Master Herbert, One book for the children's club room library.
Gluckson, Master Simeon, One book for the children's club room library.
Jenkins, Miss Dorothy, One pewter-mounted perpetual calendar for the children's garden house.
Jones, Miss Helen Swift, One book for the children's club room library.
Junior League, $10.05 for children's tuition and carfares for Brooklyn Botanic Garden classes.
Kirk, Miss Isabel, One flower bowl and holder.
McKinney, Mrs. Colin S., One book for the children's club room library.
Mothers' Club, P. S. 225, One jardiniere for the children's club room.
Mothers of Saturday Morning Pupils, $7.00 for the children's club room.
Public School 183, $5.00 for the children's club room library.
Reed, Mrs. George M., One mounted Japanese panel for the children's club room.
Shaw, Miss Ellen Eddy, One year's subscription to children's English newspaper for the children's club room. Two gold honor pins for honorable service in the outdoor garden.
Slocum, Mr. Victor, Twelve photographs of native life and rice farming in China.
Smalley, Master Melvin, One book for the children's club room library.
Weber, Mr. Julius, One mount of butterfly and moth specimens.
Woodwork Class of P. S. 90, Greenhouse implements.

Miscellaneous

Department of Parks, Brooklyn (James J. Browne, Commissioner), 120 loads of leaves.
Miss Ida May Hickox, 1 pencil sharpener.
New York Public Library (E. H. Anderson, Director), 2 photostats from Swinton's "Geography."
Mr. Victor Slocum, 12 photographs taken in China.
Mr. Adrian Van Sinderen, 2 photographs from Hawaii.
Dr. Antoine Wroblewski, Poland, 5 photographs of Municipal Gardens in Kornik.
Mr. Seymour Zolotoroffe, 2 photographic negatives of pictures taken in Botanic Garden.

APPENDIX 2

PUBLICATIONS BY THE BOTANIC GARDEN PERSONNEL DURING 1931

Becker, Hermann

Der Botanische Garten in Brooklyn, New York. Gartnerei Fachblatt. July 15.

Winterschütz für Gebolze im östlichen Nordamerika. Gartnerei Fachblatt. November 15.

Benedict, Ralph C.

Fern books to lend. *American Fern Journal* **21:** 34–48. January–March.

Native weeds. Review: Muenscher, W. C. Some changes in weed flora of Whatcom County, Washington (*Torreya* **30:** 130–134. Sept.–Oct., 1930). *American Fern Journal* **21:** 28–29. January–March.

Review: Plunkett, Charles R. Outlines of modern biology. *Bulletin of High Points* **13:** 62–63. February.

Review: Gates, R. R. Heredity and man. *Bulletin of High Points* **13:** 63–64. February.

Some contributions of technical research to elementary biology. *School Science and Mathematics* **31:** 146–151. February.

Report of the Resident Investigator. *Brooklyn Bot. Gard. Record* **20:** 128–131. March.

The responsibility of biology in health education. *Science Bulletin.* March.

Report of the editors for 1930. In collaboration with E. J. Winslow and C. A. Weatherby. *American Fern Journal* **21:** 78–79. April June.

Recent fern literature. Review: Graustein, Jeanette E. Evidences of hybridism in Selaginella. (*Bot. Gaz.* Vol. 90, Sept., 1930.) *American Fern Journal* **21:** 109–110. July–September.

Recent fern literature. Review: Kümerle, J. V. (Budapest, Hungary). Three short papers on exotic fern types. *American Fern Journal* **21:** 110. July–September.

The oldest living fern. *American Fern Journal* **21:** 111. July–September.

Tentative syllabus in general biology. State Education Department of the University of the State of New York. In collaboration with Miss Edna Craig, Mervin E. Oakes, George C. Wood, and Warren W. Knox. September.

What effect do you have on your pupils? *School Science and Mathematics* **31:** 836–840. October.

Recent fern literature. Review: Andersson-Kotto, Irma. Variegation in three species of ferns. (Zeitschrift für induktive Abstammungs- und Vererbungslehre. 1930, Bd. LVI, Heft 2, pp. 115–201.) *American Fern Journal* **21:** 139–140. October–December.

Recent fern literature. Review: Newman, Edward. A history of British ferns and allied plants. (John Van Voorst, London, 1844.) *American Fern Journal* **21:** 144–145. October–December.

Review: Hopkins, L. T. Curriculum principles and practices. *Bulletin of High Points* **12:** 67. December.

Free, Montague

Twentieth annual report of the Brooklyn Botanic Garden. Report of the Horticulturist. *Brooklyn Bot. Gard. Record* **20:** 120–127. March.

House plants. *Brooklyn Bot. Gard. Leaflets* **XIX**[1]. April 1.

Unusual but useful shrubs. *Better Homes and Gardens* **9:** 43. April.

For your rock garden. *McCall's Magazine.* May.

The rock garden of the Brooklyn Botanic Garden. Guide No. 5. *Brooklyn Bot. Gard. Record* **20:** 187–241. May.

More about rock gardens. *McCall's Magazine.* June.

For beauty in the garden. *New York Sun.* September 19.

November in your garden. *Brooklyn Bot. Gard. Leaflets* **XIX**[6]. October 21.

December in your garden. *Brooklyn Bot. Gard. Leaflets* **XIX**[10]: 1–3. December 2.

Gager, C. Stuart

The educational work of the Brooklyn Botanic Garden. IX Internat. Hort. Congress: Report and proceedings, pp. 410–413. London. February.

Report on a European trip of the director. *Brooklyn Bot. Gard. Record* **20:** 1–24. January.

Annual report of the Brooklyn Botanic Garden, 1930. Report of the director. *Brooklyn Bot. Gard. Record* **20:** 41–77. March.

Brooklyn Botanic Garden. *Brooklyn Daily Eagle.* (Long Island Ten-Year Plan Edition.) October 25.

The plant world. *Pp. viii + 136. Figs. 80.* The University Society, Inc. New York. October.

Address in presentation of gold medal to Miss Anna Billings Gallup. *Jour. Nat. Inst. Social Sciences* **15:** 56–62. October.

"At the top is magic." *Science* **74:** 569–570. December 4.

Gundersen, Alfred

Report of the Curator of Plants for 1930. *Brooklyn Bot. Gard. Record* **20:** 91–96. March.

Various abstracts in *Biological Abstracts.*

Graves, Arthur Harmount

Forest pathology. Breeding work with the chestnut. *Brooklyn Bot. Gard. Record* **20:** 83–87. March.

Report of the Curator of Public Instruction for 1930. *Brooklyn Bot. Gard. Record* **20:** 97–105. March.

"Additions to the flora of Connecticut." (Review) *Torreya* **31:** 52–53. March–April.

Important woody plants—trees, shrubs, and woody climbers—of Greater New York. *Brooklyn Bot. Gard. Leaflets* **XIX**[2–3]: 1–8. April.

Additional notes on frost crystals. *Torreya* **31:** 113–114. July–August.

"Nature rambles—spring." (Review) *Torreya* **31:** 115. July–August.

"A field key to the genera of wild and cultivated trees." (Review) *Torreya* **31:** 115–116. July–August.

The green rose, Gordonia, and the hardy chrysanthemums at the Brooklyn Botanic Garden. *Brooklyn Bot. Gard. Leaflets* **XIX**[6]: 3–4. October.

Forms and functions of leaves. *Brooklyn Bot. Gard. Leaflets* **XIX**[7–9]: 1–11. November.

The Christmas greens problem. *Home Acres*, pp. 5–6. November.

Bananas at the Brooklyn Botanic Garden. *Brooklyn Bot. Gard. Leaflets* **XIX**[10]: 3–4. December.

36 newspaper articles relating to the Brooklyn Botanic Garden.

Five Abstracts in *Biological Abstracts*.

Reed, George M.

Plant pathology. *Brooklyn Bot. Gard. Record* **20:** 78–82. March.

Hybrids of Iris fulva and Iris foliosa. *Brooklyn Bot. Gard. Record* **20:** 243–253. July.

The Iris of Japan. *Amer. Iris Soc. Bull.* **40:** 3–48. July.

Inheritance of smut resistance in hybrids of Early Gothland and Monarch Oats. *Amer. Jour. Bot.* **18:** 803–815. November.

Shaw, Ellen Eddy

Nature study at the Brooklyn Botanic Garden. *Kindergarten-6B Bulletin*, New York City. February.

The fun of gardening. *John Martin's Book*. March.

Nature study at the Brooklyn Botanic Garden in relation to New York City schools. *The North Western Naturalist* **6:** 11–13. March.

Report of the Curator of Elementary Instruction. *Brooklyn Bot. Gard. Record* **20:** 105 110. March.

Gardens: indoors and out. *American Journal of Nursing* **31:** 439–443. April.

Educational work for children at the Brooklyn Botanic Garden. *School Nature Study*, London, **26:** 58–62. July.

The following articles appeared in *McCall's Magazine* in the issues indicated:

The seed catalog. February.

A plant nursery for every home. March.

The garden soil. April.

First steps in gardening. May.

Second steps in gardening. June.

A seed bed for perennials. July.

The garden round-up. August.

Bulb planting. September.

The following articles appeared in *New Jersey Gardens* as indicated:

Winter plant friends. February.
The beginner's first steps in gardening. May.
June in the garden. June.
July in the garden. July.
Taking in the houseplants. October.

The following articles appeared in the New York *Sun* on the dates indicated:

Miniature gardens. January 3.
The care of house plants. January 10.
House plant pests. January 17.
The seed catalog: what to choose. January 24.
Repotting house plants and making cuttings. January 31.
Planting for continuous bloom. February 7.
Tools for the garden. February 14.
Starting seeds of perennials. February 21.
Shrubs for the small garden. February 28.
Transplanting seedlings. March 7.
Roses for your garden. March 14.
Starting seeds of annuals and vegetables. March 21.
How to analyze your garden soil troubles. March 28.
What fertilizers to buy. April 4.
Preparing the garden plot. April 11.
First call for planting. April 18.
What to plant for winter decoration. April 25.
Plants for shady gardens. May 2.
Plants for water gardens. May 9.
Plants for the picking border. May 16.
Care of the garden. May 23.
The formal garden. May 29.
Garden pests. June 6.
More garden pests. June 13.
Pruning of shrubs. June 20.
The picking and care of flowers. June 27.
Gladiolus, dahlias, and cannas. July 3.
The lawn and its upkeep. July 11.
How to start biennials and perennials from seed. July 18.

Midsummer in the garden. July 25.
The planting of evergreens. August 1.
Midsummer blooming lilies. August 8.
Choosing your bulbs for fall planting. August 15.
Choosing your bulbs for potting work. August 22.
Fall planting of shrubs. August 29.
Fall planting of roses. September 5.
Notes on an English garden. September 12.
The outdoor bulb bed. September 19.
Indoor gardening tools and terms. September 26.
The potting of layered bulbs. October 3.
The indoor potting of narcissus. October 10.
The potting of the Easter lily. October 17.
Taking in house plants. October 24.
The making of cuttings and shaping of plants. October 31.
Making hardwood cuttings. November 7.
The Forsythe pan. November 14.
Planting the calla lily. November 21.
Making leaf cuttings. November 28.
The Christmas pan. December 5.
The desert garden. December 12.
Plants for Christmas. December 19.
Repotting cuttings. December 26.

Svenson, H. K.

Important herbaceous plants of the Greater New York region. *Brooklyn Bot. Gard. Leaflets* **XIX**[4–5]. May 27.

List of seeds offered in exchange, 1930. *Brooklyn Bot. Gard. Record* **19:** 33–39. January.

Report of a field trip to the Catskills. *Torreya* **31:** 154–157. August.

Abstracts of the Journals *Botaniska Notiser* and Fedde's *Repertorium Specierum Novarum* for *Biological Abstracts*.

APPENDIX 3

TALKS, LECTURES, ADDRESSES, AND PAPERS GIVEN DURING 1931

By the Director:

February 2. *The botanic gardens of Italy, France, and England.* Brooklyn Botanic Garden.

February 7. *Appreciation of the services of Dr. Gustav Straubenmüller.* Testimonial Dinner by New York Principals Association, Hotel Astor, Manhattan.

April 22. *The educational and civic importance of the Brooklyn Botanic Garden.* 28th Ward Taxpayers Association, Brooklyn.

April 24. *The Botanic Garden Boulders.* Geology Club, Hunter College, Manhattan.

May 18. *Botanic gardens and art.* American Federation of Arts, Brooklyn Museum.

July 7. *Gardens within a garden.* (*The Brooklyn Botanic Garden.*) Garden Club of Bellport, L. I., Bellport.

November 28. *The educational work of the Brooklyn Botanic Garden.* Assoc. of Sci. Teachers of the Middle States and Maryland, Atlantic City.

By the Curator of Public Instruction:

March 7. *The work of the Brooklyn Botanic Garden.* New Jersey State Normal School, Biology Class. At the Garden.

April 23. *Forestry.* Biology students of Brooklyn High Schools. At the Garden.

April 28. *Arbor Day, forestry, and conservation.* Lew Wallace Junior High School.

May 7. *Types of plant nutrition.* Biology students of Brooklyn High Schools. At the Garden.

July 17. *Nature study and pedagogical principles.* Around the camp fire, New York University Summer School of Education, Lake Sebago, Sloatsburg, N. Y.

October 22. *The relation of plants to medicine.* Medical Club, James Madison High School.

October 30. *Vegetative propagation in plants.* Class from Abraham Lincoln High School. At the Garden.

November 19. *Winter characters of our native trees.* Brooklyn Nature Club, Children's Museum.

By the Curator of Elementary Instruction:

January 2. *The value of plant study.* Garden Center, Cleveland.

January 2. *Children's work at the Brooklyn Botanic Garden.* Nature Guide Banquet, Cleveland.

January 16. *Nature study for children.* Mothers' Club, P. S. 225.

January 26. *How to make a desert garden.* School Nature League.

January 28. *Graduation address,* P. S. 47.

February 9. *Home nature study for children.* Parent-Teacher Association, Edgemont School, Montclair, N. J.

March 31. *Educational work of the Brooklyn Botanic Garden.* School Nature Study Union of Great Britain, London, England.

April 20. *The educational facilities of the Brooklyn Botanic Garden for teachers and pupils.* Meeting of School Districts 32 and 34, at P. S. 26.

April 22. *Arbor Day.* Two assemblies, Girls Commercial High School.

April 24. *Arbor Day.* Three assemblies, P. S. 142.

May 2. *Children's activities at the Brooklyn Botanic Garden.* General Lord Stirling Society, C. A. R. At the Garden.

May 4. *Children's work at the Brooklyn Botanic Garden.* The Junior League. At the Garden.

May 5. *Gardening.* Parent-Teacher Association, Nathaniel Hawthorne School, Teaneck, N. J.

May 6. *Spring gardens.* Women's League, Ocean Avenue Congregational Church.

May 13. *Address of welcome.* Heads of Department Association. At the Garden.

May 14. *The value of gardening for children.* People's Institute.

May 19. *Gardening.* New Paltz Normal School.

May 27. *The work of the Brooklyn Botanic Garden.* P. S. 2 Mothers' Club. At the Garden.

June 2. *Aims in education.* Brooklyn Section, Public School Kindergarten Association. At the Garden.

June 17. *Gardening for children.* Philippstown Garden Club, Garrison, N. Y.

June 23. *Graduation address.* P. S. 139.

June 24. *Graduation address.* P. S. 119.
July 14. *Midsummer in the garden.* Brooklyn Botanic Garden Publicity Meeting, Shelter Island Heights.
September 15. *Nature study in the New York City Schools.* Conference of P. S. 219 and P. S. 235 at P. S. 219.
September 16. *The nature study syllabus of New York City for the first three grades.* P. S. 183.
September 17. *Educational opportunities for schools offered by the Brooklyn Botanic Garden.* Nature Conference, School Districts 38 and 39. At the Garden.
September 18. *Backyard gardens.* Society for Friendly Service.
September 29. *Fall in the garden.* Brooklyn Botanic Garden Publicity Meeting, Fort Salonga, Long Island.
October 1. *The indoor potting of bulbs.* Woman's Exposition, Hotel Astor.
October 3. *Educational opportunities at the Brooklyn Botanic Garden.* Class from New York University. At the Garden.
October 5. *Plant propagation.* Brooklyn Botanic Garden Publicity Meeting, Forest Hills, N. Y.
October 20. *The work of the Department of Elementary Instruction of the Brooklyn Botanic Garden.* Junior League. At the Garden.
October 30. *The work of the Department of Elementary Instruction of the Brooklyn Botanic Garden.* Forest Hills Garden Club. At the Garden.
November 4. *Nature study for little children.* Mothers' Club, P. S. 99.
November 9. *Children's work at the Brooklyn Botanic Garden.* Woman's Auxiliary of the Brooklyn Botanic Garden. At the Garden.
November 10. *The garden in the fall.* Mothers' Club of P. S. 47. At the Garden.
November 24. *Thanksgiving.* Four assemblies, Girls' Commercial High School.
December 4. *Plant propagation.* Brooklyn Botanic Garden Publicity Meeting, Bay Shore, L. I.

December 10. *Nature study.* P. S. 150.
December 23. *Christmas greens.* P. S. 235.
December 28. *Educational work at the Brooklyn Botanic Garden.* Alumnae Association, Tufts College.

By the Curator of Plant Pathology:

January 19. *Irises in Japan.* At the Garden.
February 17. *An iris pilgrimage to Japan.* Pennsylvania Horticultural Society, Philadelphia, Pa.
February 18. *The iris of Japan.* The Woman's Club of Ridgewood, N. J.
February 27. *Gardens of Japan.* Japan Society of Boston, Mass.
March 4. *Gardens of Japan.* The Garden Club of Greater New Bedford, Mass.
April 13. *Iris of Japan.* Garden Club of New Rochelle, N. Y.
May 4. *Gardens of Japan.* Cambridge Club. At the Garden.
May 13. *Gardens of Japan.* Plainfield Garden Club, N. J.
June 1. *IIistory and culture of the iris.* At the Garden.
September 9. *The iris of Japan.* Madison, Conn. Garden Club.
October 16. *Illustrations of plant breeding.* Biology Class, Abraham Lincoln High School. At the Garden.

By the Curator of Plants:

January 1. *The sequence of genera within the family.* The Systematic Section, Botanical Society of America, Cleveland.
January 26. *Report on a trip to England, Scandinavia, Russia and Germany.* Brooklyn Botanic Garden.
January 30. *Pre-Linnaean Botanists.* At the Garden.
May 26. *Ornamental Shrubs.* Garden Club, Saugerties, N. Y.

By the Assistant Curator of Plants:

January 12. *Report of trip to the Galapagos and Cocos Islands.* Illustrated. Brooklyn Botanic Garden Staff. At the Garden.
February 13. *Early botanical exploration in North America.* (History of Botany Talks to the Public.) At the Garden.

February 20. *Modern trends in systematic botany.* (History of Botany Talks to the Public.) At the Garden.
April 1. *Our native plants.* Nature Club, Paterson High School.
April 25. *The Galapagos Islands.* Brooklyn Polytechnic Institute, Chemistry Club.
December 24. *The Brooklyn Botanic Garden.* Junior Chamber of Commerce.

By the Horticulturist:

March 6. *The annual flower garden.* Garden Institute in connection with Co-operative Extension Work in Agriculture and Home Economics of the State of New Jersey, Hackensack.
March 11. *Rock gardens.* Norwalk Garden Club, South Norwalk, Conn.
March 25. *Annual flowering plants.* Garden Institute in connection with Co-operative Extension Work in Agriculture and Home Economics of the State of New Jersey, Trenton.
March 26. *Annuals and perennials.* Garden Institute in connection with Co-operative Extension Work in Agriculture and Home Economics of the State of New Jersey, Paterson.
March 28. *Annual flowering plants.* Garden Institute in connection with Co-operative Extension Work in Agriculture and Home Economics of the State of New Jersey, Collingswood.
March 28. *Perennial garden.* Garden Institute in connection with Co-operative Extension Work in Agriculture and Home Economics of the State of New Jersey, Collingswood.
April 2. *Alpine and rock gardens.* Englewood Garden Club.
April 15. *Rock gardens.* Conducting discussion at the New York Horticultural Society.
April 22–October 7. *Course of eight lessons in gardening.* Lawrence Garden Club.
June 25. *Rock gardens.* Newport (R. I.) Garden Association.
June 30. *Brooklyn Botanic Garden.* Roslyn Garden Club.
October 2. *Fall planting of roses.* Exposition of Women's Work, at Hotel Astor.

October 3. *Pruning.* Exposition of Women's Work, at Hotel Astor.
October 5. *Rock gardens.* Bronxville Garden Club.
October 14. *Rock gardens.* Women's Club of Lebanon (Penna.).
October 20. *Putting the garden to bed.* Lawrence Garden Club.
October 28. *House plants.* Society of Little Gardens, Philadelphia.
November 23. *Rock gardens.* Flushing Garden Club.

By the Resident Investigator (Ferns):

March 3. *Some aspects of secondary high school biology teaching.* Torrey Botanical Club, Columbia University.
April 16. *Eugenics: A biologist looks into the future.* American Museum of Natural History.
May 14. *Plant breeding.* Brooklyn Botanic Garden.
May 21. *The growth of the idea of evolution.* Brooklyn Botanic Garden.
May 28. *The growth of the idea of evolution.* John Adams High School.
November 12. *How Uncle Sam breeds novel plants.* American Museum of Natural History.
November 12. *The significance of Dr. Eddy's vitamin discoveries.* In collaboration with Dr. Walter H. Eddy. Station WJZ, under auspices of American Institute Popular Science Series.
December 16. *Breeding new kinds of plants.* Brooklyn College Biology Club.
December 18. *Plant breeding, new and old.* American Museum of Natural History.

By Instructors:

Miss Dorward:

February 9. *Nature study for children.* Parent-Teachers Association, Jefferson School, New York.
April 16. *First steps in gardening.* Mothers' Club, P. S. 222.

December 2. *Educational activities of the Brooklyn Botanic Garden.* Garden Club, Maxwell Training School for Teachers.

Miss Miner:

January 27. *Opportunities offered to children at the Brooklyn Botanic Garden.* United Parents' League.

May 6. *A spring garden.* Women's Benevolent Society, Marcy Avenue Baptist Church.

By the Registrar and Custodian:

January 31. *Work of the Brooklyn Botanic Garden and its availability to Scouts.* Prospect Y. M. C. A., Troop 237, Boy Scouts of America.

April 11. *Branching habits of trees.* St. Mark's M. E. Church, Troop 24, Boy Scouts of America.

July 23. *Identification of trees.* Staten Island Council Camp, Boy Scouts of America, New Dorp, Staten Island.

July 24. *Ferns in their habitats.* Camp Silver Spruce, Tuxedo, New York.

July 25. *Woodcraft and handicraft.* Camp Silver Spruce, Tuxedo, New York.

APPENDIX 4

REPORT ON BROOKLYN BOTANIC GARDEN PUBLICATIONS, 1931

American Journal of Botany

Official Organ of the Botanical Society of America

Volume XVIII (1931) comprised, as usual, ten monthly issues (omitting August and September), with 68 papers, 887 pages, 64 plates, and 280 text figures (as against 70 papers, 1005 pages, 63 plates, and 241 text figures in 1930). Two papers were published on the "author payment" plan. Dr. Arthur Harmount Graves continued on the editorial board as representative of the Brooklyn Botanic Garden. Dr. Edmund W. Sinnott, of Columbia University, continued as Editor-in-Chief.

The circulation at the close of the fiscal year (November 30, 1931) was 1704 as against 1673 one year ago. The annual budget

was $15,660.40 against $19,073.51 in 1930. The year closed with a credit balance of $4,261.30 and assets over liabilities of $5,-421.30 plus the value of back sets and volumes on hand.

Ecology

Official Organ of the Ecological Society of America

Quarterly. Volume XII comprised 43 papers (besides reviews, proceedings, and miscellaneous matter), 744 pages and 258 text figures (as against 52 papers, 797 pages, 20 plates, and 177 text figures in 1930). The circulation at the close of the fiscal year (November 30, 1931) was 1140 as against 1095 one year ago.

The annual budget was $5634.31, the credit balance $399.55 and liabilities over assets $343.18 (against $6486.31, $204.00, and $146.73 assets over liabilities in 1930) plus back sets and volumes on hand. Dr. Alfred Gundersen continued, for the second year, on the editorial board as the Brooklyn Botanic Garden representative. Mr. Barrington Moore, who was active in the establishment of "Ecology," and who has been its efficient editor from the first issue, January 1920, presented his resignation to take effect as of December 31, 1931. At the annual meeting of the Ecological Society of America in New Orleans, the last week in December, it was decided to have an associate editor as well as an editor. By this plan both the botanical and zoological aspects of ecological science have a responsible editor (in addition to the other members of the editorial board). Prof. Alfred E. Emerson, of the zoological department, University of Chicago, was elected Editor, and Prof. George D. Fuller, of the department of botany, University of Chicago, Associate Editor, both beginning as of January 1, 1932.

Genetics

In Cooperation with the Editorial Board of Genetics

Bimonthly. Volume XVI comprised 33 papers, 680 pages, 12 plates, and 112 text figures (as against 18 papers, 589 pages, 7 plates, and 67 text figures in 1930). At the close of the fiscal year (November 30, 1931) the circulation was 685, the annual budget $5474.44, the credit balance $719.24, and assets over liabilities $1161.59 (as against 680, $5916.53, $459.26, and $676.63 in 1930). Dr. Donald F. Jones, Connecticut Agricultural College, continued as Editor-in-Chief.

Brooklyn Botanic Garden Record

Bimonthly. Volume XX (1931) comprised 294 pages. As usual, the March number comprised the Annual Report. The May number constituted the Guide to the Rock Garden (Guide No. 5), and the July number was devoted to Dr. George M. Reed's report on hybrids of *Iris fulva* and *Iris foliosa*, with a double page colored plate. The November number was the first published Guide to the Japanese Garden (Guide No. 6). The circulation of the RECORD at the close of the year was 1601.

Leaflets

Three single numbers and three double numbers were issued. The circulation as of December was 1750 copies. Dr. Arthur Harmount Graves, curator of public instruction, is the editor.

Contributions and Memoirs

Numbers 59, 60, and 61 of the *Contributions* were published. No *Memoir* was issued.

APPENDIX 5

FIELD TRIPS CONDUCTED

By the Curator of Public Instruction:

February 15. Torrey Botanical Club. To Kreischerville, Staten Island, to see stand of *Pinus virginiana*.

July 18. New York University Summer School of Education. Trip near Sebago Lake, N. Y., to see various species of woody plants.

September 13. Torrey Botanical Club. To Fresh Kills, Staten Island.

By the Curator of Plants:

May 16. Brooklyn Institute of Arts and Sciences, Department of Botany, to Hollis, L. I.

Aug. 22–29. Torrey Botanical Club. To Hunter, Overlook, and Blackhead Mts. in the Catskills.

Sept. 19. Torrey Botanical Club. To the Palisades for goldenrods.

By the Resident Investigator (Ferns):

May 16. New York Association of Biology Teachers. Pound Ridge Reservation, New York.

By the Assistant Curator of Plants:

May 16. New York Association of Biology Teachers. Pound Ridge, N. Y.

May 31. Botany Club, Paterson High School. Franklin Lake, N. J.

June 7. Torrey Botanical Club. Bay Terrace, S. I.

Aug. 24–28. Torrey Botanical Club. With Dr. Alfred Gundersen, Maplecrest, N. Y. A biological study of the Catskills.

Oct. 3. Torrey Botanical Club. Queens Village, L. I. Study of asters.

Oct. 10–12. Torrey Botanical Club and Green Mountain Club. Week-end at Montauk Point.

APPENDIX 6

MEETINGS OF ORGANIZATIONS AT THE GARDEN 1931

March 18. Torrey Botanical Club.

April 13. Woman's Auxiliary of Brooklyn Botanic Garden.

April 25. Torrey Botanical Club.

April 28. Educational Committee of the Biology Association of New York City.

May 2. General Lord Sterling Society, C. A. R.

May 2. Reconciliation Tours.

May 4. Cambridge Club.

May 4. Junior League of Brooklyn.

May 4. Winter Nights Club.

May 6. Women of '76 Chapter, D. A. R.

May 6. South Shore Garden Club of Connecticut.

May 13. Heads of Department Association of Brooklyn, New York.

May 18. American Federation of Art.

May 19. Brooklyn Community Center.

May 23. Garden Club of Far Rockaway High School.

May 27. Mothers Club of Public School 2.

June 2. Brooklyn Kindergarten Association.

June 30. American Iris Society.

July 8. Staten Island Garden Club.
July 17. Vacation Church School of First M. E. Church, Queens, Long Island.
October 5. Presbyterian Staff of Brooklyn.
October 13. Department of Botany, Brooklyn Institute of Arts and Sciences.
October 20. Junior League of Brooklyn.
October 30. Forest Hills Garden Club.
October 31. Conservation Division of New York City Federation of Women's Clubs.

Number of organizations	23
Total attendance	1,146

APPENDIX 7

REPORT ON PHOTOGRAPHIC WORK

Negatives on file December 31, 1930		7,000
Negatives accessioned during 1931		310
Total negatives on file December 31, 1931		7,310
Lantern slides on file December 31, 1930		5,450
Lantern slides accessioned during 1931		280
Total lantern slides on file December 31, 1931		5,730
Prints on file December 31, 1930		3,376
Prints made during 1931	2,821	
Used or distributed	2,511	
Prints filed during 1931		310
Total prints on file December 31, 1931		3,686
Enlargements made		141

Respectfully submitted,

FRANK STOLL,
Registrar.

APPENDIX 8

PLAN OF COOPERATION BETWEEN LONG ISLAND UNIVERSITY AND BROOKLYN BOTANIC GARDEN

I. EXTENSION COURSES FOR CREDIT.

1. Courses Leading to Undergraduate Credit.

Courses given at the Botanic Garden, which con-

form to academic standards approved by Long Island University in regard to content and method of instruction, shall be accepted by Long Island University for undergraduate credit. These standards require the courses to be given in the form of lectures, quizzes or laboratory instruction, assigned reading, and examinations.

The instructors giving these courses shall be trained in conformity with the usual academic standards.

2. *Registration of Students.*

Students registered in an accepted Botanic Garden course, who desire to obtain credit from the University, shall meet the admission requirements of the University, register with the University Registrar, and pay a registration fee of $10 each semester.

3. *Granting of Degrees.*

Students referred to in paragraph 2 who have met the requirements of an accepted course may receive undergraduate credit from the University. Students who have studied in other institutions of collegiate standing may apply for advanced standing in the University.

Upon completion of the requirements of Long Island University for graduation in the arts or in the sciences, the student may apply for the degree of Bachelor of Arts or Bachelor of Science.

II. Graduate Credit.

As the University has not as yet established a Graduate School, it cannot confer credits leading toward a graduate degree.

III. Other Privileges.

Long Island University agrees to place at the disposal of the Botanic Garden the services of the Professor of Botany in an advisory capacity. The Botanic Garden agrees to permit properly qualified students of Long Island University the use of its library and herbaria, under the regulations governing their general use.

IV. CATALOGUE NOTICES.

Notice of the cooperation of the Botanic Garden with the University shall appear in the official Prospectus of the Botanic Garden and in the official catalogue of the University.

For Long Island University
(Signed) GEORGE R. HARDIE,
Dean.

For Brooklyn Botanic Garden
(Signed) C. STUART GAGER,
Director.

Brooklyn, N. Y.,
January 26, 1931.

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Through the Botanic Garden	22	
Through Other Departments	243	
		265
Sustaining Members		
Through the Botanic Garden	22	
Through Other Departments	45	
		67
Annual Members		682
Total		1,160
Less Duplications		35
Net Total		1,125

THE BOTANIC GARDEN AND THE CITY

THE BROOKLYN BOTANIC GARDEN, established in 1910, is a Department of the Brooklyn Institute of Arts and Sciences. It is supported in part by municipal appropriations, and in part by private funds, including income from endowment, membership dues, and special contributions. Its articulation with the City is through the Department of Parks.

The City owns the land devoted to Garden purposes, builds, lights, and heats the buildings, and keeps them in repair, and includes in its annual tax budget an appropriation for other items of maintenance. One third of the cost of the present buildings (about $300,000) was met from private funds.

All plants have been purchased with private funds since the Garden was established. In addition to this, it has been the practice of the Garden to purchase all books for the library, all specimens for the herbarium, all lantern slides, and numerous other items, and to pay certain salaries, with private funds.

The needs of the Garden for private funds for the endowment of research in progress now, the development of the Library and Herbarium, and the normal expansion and enrichment of its scientific and educational work, are twice as great as the present income from endowment, membership dues, and special contributions.

The director will be glad to give detailed information concerning these needs to any who may be interested.*

* A written *Agreement,* dated August 17, 1914, between the City of New York and the Institute, touching the Botanic Garden, published in full in the *Brooklyn Botanic Garden Record,* for April, 1915, amends the agreement of September 9, 1912, which amends the original agreement of September 28, 1909, published in the *Record* for January, 1912.

INFORMATION CONCERNING MEMBERSHIP

The Brooklyn Institute of Arts and Sciences is organized in three main departments: 1. The Department of Education. 2. The Museums. 3. The Botanic Garden.

Any of the following seven classes of membership may be taken out through the Botanic Garden:

1. Annual member	$ 10
2. Sustaining member	25
3. Life member	500
4. Permanent member	2,500
5. Donor	10,000
6. Patron	25,000
7. Benefactor	100,000

Sustaining members are annual members with full privileges in Departments one to three. Membership in classes two to seven carries full privileges in Departments one to three.

In addition to opportunities afforded to members of the Botanic Garden for public service through cooperating in its development, and helping to further its aims to advance and diffuse a knowledge and love of plants, to help preserve our native wild flowers, and to afford additional and much needed educational advantages in Brooklyn and Greater New York, members may also enjoy the privileges indicated on the following page.

Further information concerning membership may be had by addressing The Director, Brooklyn Botanic Garden, Brooklyn, N. Y., or by personal conference by appointment. Telephone, Prospect 9-6173.

PRIVILEGES OF MEMBERSHIP

1. Free admission to the buildings and grounds.
2. Cards of admission for self and friends to all exhibitions and openings preceding the admission of the general public, and to receptions.
3. Services of docent (by appointment), for self and party, when visiting the Garden. Arrangements should be made one day in advance.
4. Free admission of member and his or her immediate family to all lectures, classes, field trips, and other scientific meetings under Garden auspices, at the Garden or elsewhere.
5. Invitations for self and friends to spring and fall "Flower Days."
6. Special lectures and classes for the children of members.
7. Copies of Garden publications, as follows:
   a. Record
   b. Guides
   c. Leaflets
   d. Contributions
8. Frequent Announcement Cards concerning plants in flower and other exhibits.
9. Privileges of the Library and Herbarium.
10. Expert advice on the choice and care of plants, indoors and out, on planting the home grounds, the care of lawns, and the treatment of plants affected by insect and fungous pests.
11. Identification of botanical specimens.
12. Participation in the periodical distribution of duplicate plant material and seeds, in accordance with special announcements sent to members from time to time.

Membership in the Brooklyn Botanic Garden affords an opportunity to become a part of and to participate in a work of great civic and educational value in the community. Many have taken out membership from this motive, as well as for (or aside from) the personal advantages afforded members.

FORMS OF BEQUEST TO THE BROOKLYN BOTANIC GARDEN

Form of Bequest for General Purposes

I hereby give, devise, and bequeath to The Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., the sum of.....Dollars, the income from which said sum to be used for the educational and scientific work of the Brooklyn Botanic Garden.

Form of Bequest for a Curatorship

I hereby give, devise, and bequeath to The Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., the sum of.....Dollars, as an endowment for a curatorship in the Brooklyn Botanic Garden, the income from which sum is to be used each year towards the payment of the salary of a curator in said Botanic Garden, to be known as the (here, if desired, may be inserted the name of the donor or other person) curatorship.

Form of Bequest for a Fellowship

I hereby give, devise, and bequeath to The Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., the sum of.....Dollars, the income from which sum is to be used in the payment of a fellowship for advanced botanical investigation in the Brooklyn Botanic Garden, to be known as the

.....fellowship.

Form of Bequest for other particular purposes designated by the testator

I hereby give, devise, and bequeath to The Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., the sum of.....Dollars, to be used (or the income from which to be used) for the Brooklyn Botanic Garden *

.....

.....

* The following additional purposes are suggested for which endowment is needed.

1. Botanical research.
2. Publishing the results of botanical investigations.
3. Popular botanical publication.
4. The endowment of a lectureship, or a lecture course.
5. Botanical illustration for publications and lectures.
6. The purchase and collecting of plants.
7. The beautifying of the grounds.
8. The Herbarium.
9. The purchase of publications for the library.
10. Extending and enriching our work of public education.

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GENERAL INFORMATION

Membership.—All persons who are interested in the objects and maintenance of the Brooklyn Botanic Garden are eligible to membership. Members enjoy special privileges. Annual Membership, $10 yearly; Sustaining Membership, $25 yearly; Life Membership, $500. Full information concerning membership may be had by addressing *The Director, Brooklyn Botanic Garden, 1000 Washington Avenue, Brooklyn, N. Y.* Telephone, Prospect 9-6173.

The Botanic Garden is open free to the public daily from 8 a.m. until dusk; on Sundays and Holidays it is open at 10 a.m.

Entrances.—On Flatbush Avenue, near Empire Boulevard and near Mt. Prospect Reservoir; on Washington Avenue, south of Eastern Parkway and near Empire Boulevard; on Eastern Parkway, west of the Museum Building.

The street entrance to the Laboratory Building is at 1000 Washington Avenue, opposite Crown Street.

To Assist Members and others in studying the collections the services of a docent may be obtained. This service is free of charge to *members of the Botanic Garden;* to others there is a charge of 50 cents per person. Arrangements must be made by application to the Curator of Public Instruction at least one day in advance. No parties of less than six adults will be conducted.

To Reach the Garden take Broadway (B.M.T.) Subway to Prospect Park Station; Interborough Subway to Eastern Parkway-Brooklyn Museum Station; Flatbush Avenue trolley to Empire Boulevard; Franklin Avenue, Lorimer Street, or Tompkins Avenue trolleys to Washington Avenue; St. John's Place trolley to Sterling Place and Washington Avenue; Union Street or Vanderbilt Avenue trolleys to Prospect Park Plaza and Union Street. By Automobile from points on Long Island take Eastern Parkway west and turn left at Washington Avenue; from Manhattan, take Manhattan Bridge, follow Flatbush Avenue Extension and Flatbush Avenue to Eastern Parkway, turn left following Parkway to Washington Avenue; then turn right.

BROOKLYN BOTANIC GARDEN
PUBLICATIONS

RECORD. Established, January, 1912. An administrative periodical issued quarterly (1912–1928); bimonthly beginning with 1929. Contains, among other things, the *Annual Report* of the director and heads of departments, special reports, announcements of courses of instruction, seed list, guides, miscellaneous papers, and notes concerning Garden progress and events. Free to members of the Garden. To others $1.50 a year. Circulates in 59 countries.

MEMOIRS. Established, July, 1918. Published irregularly. Circulates in 47 countries.

Volume I. *Dedication Papers:* comprising 33 scientific papers presented at the dedication of the laboratory building and plant houses, April 19–21, 1917. 521 pages. Price $3.50, plus postage.

Volume II. The vegetation of Long Island. Part I, The vegetation of Montauk: A study of grassland and forest. By Norman Taylor, June 11, 1923. 108 pages. Price $1.00, plus postage.

Volume III. Vegetation of Mount Desert Island, Maine, and its environment. By Barrington Moore and Norman Taylor, June 10, 1927. 151 pages. Price $1.60.

CONTRIBUTIONS. Established, April 1, 1911. Papers originally published in periodicals, reissued as "separates," without change of paging, and numbered consecutively. This series includes occasional papers, as well as those embodying the results of research. Twenty-five numbers constitute one volume. Price 25 cents each, $5.00 a volume. Circulates in 34 countries.

61. Inheritance of smut resistance in hybrids of early Gothland and Monarch oats. 13 pages. 1931.

62. Physiologic races of Ustilago levis and U. avenae on red oats. 00 pages. 1932.

63. Inheritance of resistance to loose and covered smut in a hybrid of Early Gothland and Victor oats. 10 pages. 1932.

64. Inheritance of resistance to loose and covered smut in hybrids of Hull-less with Early Gothland and Monarch oats. 28 pages. 1932.

LEAFLETS. Established, April 10, 1913. Published weekly or biweekly during April, May, June, September, and October. The purpose of the *Leaflets* is primarily to give announcements concerning flowering and other plant activities to be seen in the Garden near the date of issue, and to give popular, elementary information about plant life for teachers and others. Free to members of the Garden. To others, fifty cents a series. Single numbers 5 cents each. Circulate in 28 countries.

GUIDES to the collections, buildings, and grounds. Price based upon cost of publication. Issued as numbers of the *Record;* see above.

Guide No. 5. The Rock Garden. 28 illustrations. Price, 35 cents. By mail, 40 cents.

Guide No. 6. Japanese Potted Trees (Hachinoki). 11 illustrations. Price, 35 cents. By mail, 40 cents.

SEED LIST. (*Delectus Seminum*) Established, December, 1914. Since 1925 issued each year in the January number of the RECORD. Circulation includes 160 botanic gardens and institutions located in 40 countries.

AMERICAN JOURNAL OF BOTANY. Established, January, 1914. Published, in coöperation with the BOTANICAL SOCIETY OF AMERICA, monthly, except during August and September. Subscription, $7.00 a year. Circulates in 53 countries.

ECOLOGY. Established, January, 1920. Published quarterly in coöperation with the ECOLOGICAL SOCIETY OF AMERICA. Subscription, $4.00 a year. Circulates in 48 countries.

GENETICS. Established, January, 1916. Bimonthly. Subscription, $6.00 a year. Circulates in 37 countries.

BROOKLYN BOTANIC GARDEN RECORD

VOL. XXI MAY, 1932 NO. 3

THE STORY OF OUR BOULDERS

GLACIAL GEOLOGY OF THE BROOKLYN BOTANIC GARDEN

GUIDE No. 7

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FIG. 1. The Brook, Brooklyn Botanic Garden, facing north (up stream), showing glacial boulders, 1921. Cf. Fig. 4. (3698)

BROOKLYN BOTANIC GARDEN RECORD

VOL. XXI MAY, 1932 NO. 3

THE STORY OF OUR BOULDERS

INTRODUCTION

By C. Stuart Gager

"It rejoices me to think that, when a boy, I was shown an erratic boulder in Shrewsbury, and was told by a clever old gentleman that till the world's end no one would ever guess how it came there."—*Charles Darwin to J. D. Hooker,* 1862.

"We must assume an ice period."—*Louis Agassiz* (1850).

"Sticks and stones have a story to tell."—*Hugh Miller* (about 1854).

"The track of a glacier is as unmistakable as that of a man or a bear."
—*John Newberry* (1870).

Discovery of the Boulders

A visitor to the Brooklyn Botanic Garden will soon have his attention arrested by the considerable number of large rocks or *boulders* of various size and composition in all parts of the grounds. When the property was first assigned to the Board of Trustees, for development as a botanic garden, there were a number of these boulders lying on the surface of the ground at various points, chiefly in the northern portion.

When (in 1913–1914) the area between the Museum Building and Mt. Prospect reservoir was graded down, by some eight or ten feet, to the street level of Eastern Parkway, large quantities of these boulders were uncovered. They varied in size from small cobble stones and coarse gravel to boulders much larger than a roll-top desk.

Uses of the Boulders

The uncovering of these boulders at once solved the problem of a rock garden, for, with the exception of a small outcrop of metamorphic rocks in a narrow strip along East River, at the west end

FIG. 2. Rock Garden, Brooklyn Botanic Garden, looking north, showing utilization of glacial boulders. (2582)

of the Island, near Astoria and Long Island City, there are no outcrops of bedrock on Long Island. At the Brooklyn Botanic Garden bedrock is 400–500 feet below sea level. The large boulders, therefore, afforded the most logical material for a rock garden on Long Island, and quantities of them were used for that purpose.

In connection with other grading in what is now the Native Wild Flower Garden, and north of the Japanese Garden, it became desirable to construct two retaining walls, and some of the boulders were used to good effect for that purpose.

The boulders have also been of value to the Garden in the construction of ten dams in the artificial brook that runs through the garden, in the construction of boulder bridges over the brook, as mountings for bronze tablets, and otherwise.

A Puzzle to Solve

But how did it happen that there came to be such quantities of these large boulders in this locality? Geology teaches us that the various features of the earth's surface *have come to be* as we now find them by a series of gradual changes, and are therefore sub-

FIG. 3. Glacial boulders uncovered during grading operations in Brooklyn Botanic Garden, North Addition, 1913. Site of present Rose Garden and Lilac Triangle. (1314)

ject to explanation. Every locality has had its history, extending through aeons of geological time. If we wish to explain the presence of the boulders in the Botanic Garden we are brought face to face with the problem of the geological history of the Botanic Garden site.

What Is an Explanation?

The first step toward explaining a thing is to describe it accurately. In fact, scientific explanation consists largely (some scientists say wholly) in extended, detailed, and accurate description. We shall, therefore, describe the boulders and also the geological and topographic features of the Botanic Garden as the first and necessary step in unravelling the mystery of the origin of these boulders.

The "Back Bone" of Long Island

One who walks through the Garden will notice at once that the land in the northern portion is considerably higher than in the southern part. Just west of the Laboratory Building is a considerable hill with a large boulder resting on the surface at the top, and known, from this feature, as Boulder Hill.

If one travels eastward on Long Island, or (more conveniently) studies a topographic map of the Island, he will see that this high land extends as a conspicuous ridge from Fort Hamilton, on the west, through Prospect Park and the Botanic Garden to Montauk Point, at the eastern extremity of the Island. This ridge, sometimes referred to as the "back bone" of Long Island, lies (in the western part) considerably nearer the north shore than the south shore. At and near the eastern end of the Island the ridge has been worn away by the action of ocean waves and this explains the cliffs near Montauk. But, wherever the ridge has been worn away by the waves, or exposed by excavation, it is found to be composed of sand and gravel in which are imbedded big boulders.

A similar ridge may be traced all the way from southern Rhode Island across Fisher's Islands and Plum Island to Orient Point, and thence along or close to the northern shore of Long Island to about the vicinity of Manhasset, where it joins the other ridge.

FIG. 4. Glacial boulders placed along the Brook under construction, 1912. Facing north—up stream. (562). Cf. Fig. 1.

The Southern Plain of Long Island

South of the gravel ridge is a gently sloping plain, forming part of the *coastal plain* of eastern North America, and placed as a *frontal apron* with reference to the ridge. This plain is more or less dissected by valleys ten to twenty feet deep, whose streams (where they have not dried up) rise in the highland and flow in a direction a little west of south to the ocean. One of these valleys, about three miles east of Garden City and Mineola, is occupied by East Meadow Brook, and another by Hempstead Brook, flowing through the town of Hempstead.

It has been observed that, in places, the western slopes of these valleys seem to be steeper than the eastern, and the suggestion was made by Elias Lewis, Jr., in 1877 (*Am. Jour. of Science and Arts,* Ser. III, Vol. 13, p. 215) that this was due to the rotation of the earth *from west to east.* Owing to the inertia of the water the streams have tended to maintain their southern course and have

thus, by the motion of the earth, been forced against their west banks and have consequently eroded or under-cut them more than the east banks. Careful studies made since this hypothesis was first proposed have raised grave doubts as to whether the facts really justify the conclusion, and the suggestion must be taken, not as demonstrated fact, but merely as an interesting hypothesis, to be tested by further study.

A Prairie on Long Island

A portion of the Long Island Plain, comprising about 50 square miles in the center of Nassau County, and about midway between the north and south shores of the Island, is known as the "Hempstead Plains." In a report on the field operations of the U. S. Bureau of Soils for 1903, J. A. Bonsteel referred to this area as being "a natural prairie east of the Allegheny Mountains. It was treeless when first discovered and was originally used as commons for the pasturage of cattle and horses belonging to individuals and communities." As Dr. Roland M. Harper has noted, "there is not another place exactly like it in the world."

Over an area of several thousand acres the flora is almost exclusively of native plants, and this is one of the evidences that it has never been artificially deforested and has never been under the plow, for after a virgin area in the eastern United States is plowed European weeds come in and tend to crowd out the native flora.

"The natural vegetation," says Harper, "may be divided into two habitat groups: that of uplands and that along watercourses. . . . There is also a characteristic weed vegetation along roads and in abandoned fields. . . . The upland vegetation is by far the most extensive but that of the valleys is (or was) a little richer in species."

If one excavates in the coastal plain or frontal apron above referred to, he will find pebbles, gravel, and sand (that could have been moved by streams of water), and here and there layers of clay. In digging the channel for the Botanic Garden brook large boulders were continually uncovered, beginning at the outlet of the Lake and extending to a point just down stream from the Hills Boulder Bridge. South of that point fewer large boulders

were found. The big one on Rock Island was moved to the Island from farther north. Some of the material south of the bridge may possibly have been laid down under water, in an ancient local lake or pond, for it is *stratified,* with the coarser material at the bottom, just as always occurs when a mixture of materials of various degrees of coarseness and fineness is allowed

FIG. 5. Glacial boulders uncovered during grading operations in front of the Laboratory Building, Brooklyn Botanic Garden, 1931. (7326)

to settle (by *sedimentation*) in more or less quiet water. On the whole, however, the material of the frontal apron or "outwash plain" on Long Island is composed of cross-bedded material deposited on a water-soaked plain. As a rule, the material of the "back bone" ridge is not stratified. Gravel often overlies the finer sand; finer clay may lie underneath the gravel. Obviously, this material was *not* laid down under water.

The Boulders Were Brought Here

Moreover, it seems quite clear that many of the larger boulders could hardly have been transported by flowing water alone—yet transported they must have been, for they must have been derived from bedrock and brought by some agency to their present resting places. In recognition of that fact the rocks are commonly called *erratic boulders* (boulders that have "wandered"). Whence did they come, and how? What was the origin of the "back bone"

FIG. 6. Boulder bridge in the Brooklyn Botanic Garden showing one use of the glacial boulders. (6811)

of Long Island, which extends across the northern portion of the Brooklyn Botanic Garden? What the origin of the plain to the south of it?

Peculiarities of the Boulders

That the boulders on Long Island are of rounded contour and smooth surface seems to have been recorded first by Timothy Dwight, president of Yale College from 1795–1817. In Volume III of his *Travels in New England and New York,* page 279 (London, 1823), describing his journey on Long Island, there occurs this rather remarkable passage:

"When we commenced our journey on this island, I proposed to my companions to examine with a continued and minute attention, the stones of every size, which should be visible to us throughout all the parts of our progress. This examination was made by us all with great care, and was extended to the stones on the general surface, to those washed out in hollow roads, to those uncovered on the summits and sides, and at the bottom of hills, to those found in the deepest valleys, and to those which were dug out of a considerable number of very deep wells. The result of this examination was, that all the stones which we saw were, without an exception, destitute of angles, limited by an arched exterior, appearing as if worn by the long-continued attrition of water, and in all respects exactly like those, which in a multitude of places we found on the beach of the ocean. In ten or twelve instances, possibly a few more, we observed small blocks of granite on our road. Every one of these exhibited what I thought plain proofs of having been washed for a considerable length of time . . . we did not find in a progress of more than two hundred miles, a single stone which did not exhibit proofs of having been washed for a considerable period."

Noah's Flood on Long Island

"From this extraordinary fact," President Dwight continues, "it would seem to be a natural conclusion that the great body of this island, or perhaps more properly the materials of which it is composed, were at some former period covered by the ocean, and by a cause which cannot now be discovered, were thrown up into their present form."

After discussing and rejecting volcanic action and "movements of the ocean" as causes, Dwight continues:

FIG. 7. Glacial Boulder, Brooklyn Botanic Garden, used as a mounting for the Parmentier bronze tablet. This boulder is approximately 7 feet high and 7 feet in greatest thickness. (7937)

"Plainly no convulsion recorded in history, except the deluge, will account at all for these appearances, nor for innumerable others visible in many parts of both continents. That Long Island was deeply affected by this great shock of nature is, I think, unquestionable from a variety of facts."

How Were the Boulders Transported?

The history of the attempts to explain the riddle of the boulders emphasizes the importance of a correct method in science. In the more or less loose thinking employed in the common experiences of daily life, we interpret what we observe in the light of ideas we

have already accepted without very carefully testing their validity. Often the observations themselves are far from accurate. But the essence of scientific method is to observe and describe accurately, make careful comparisons, formulate with great caution our guess or hypothesis as to the cause of what we observe, entertaining no guess that the facts do not justify, and finally rigidly testing our hypothesis, ready to reject it if it does not square with other facts, and does not enable us to make accurate predictions.

Disregarding the caution imposed by scientific method and accepting the teaching that the earth's features had resulted from a series of "catastrophes," rather than from gradual transformation by the action of causes still in operation, the geologists, Von Buch and de Luc, inferred that the boulders were hurled through the air like cannon balls by the force that was supposed to have uplifted neighboring mountains. Other writers, like President Dwight, as quoted above, enlisted the aid of Noah's flood. This was the explanation given by Tomlinson in 1833 to the glacial deposits of the Mohawk valley. The flood theory of the drift was also accepted at one time by Amos Eaton, professor of botany at Yale, 1864–1895.

Others pinned their faith to the collision of a comet with the earth. Currents, tides, and waves from the north (caused by the bursting of hypothetical lakes, the inrush of the ocean, or otherwise) won the support of Hayes (1839) and others. The great English geologist, Lyell, at one time, and Mather (1843) and others in America thought the boulders were transported only by icebergs.

Light from Switzerland

It seems probable that the honor of first suggesting the correct explanation belongs to Perraudin, a chamois-hunter of Switzerland. This unlearned man noticed the huge erratic blocks on the Jura mountain crests, and pondered on the manner in which they had been carried *from a lower to a higher level.* He had probably never heard of the geologists and their theories, but he had seen the valley glaciers of his native land and observed them transporting boulders. It was "common sense" with him to infer the same agency for the transportation of "erratics." This idea he pro-

FIG. 8. Erratic boulder near Roslyn, L. I., sheltering the Physiographers Club of New York—28 persons. (From Barton W. Stone Collection, Columbia University. Courtesy of Prof. A. K. Lobeck.) (7990)

posed to the local director of mines, Jean de Charpentier, in 1815, but that scientist only laughed at the absurd notion. Nearly ten years later, he told his belief to Venetz, who gave it credence and embodied it in a paper read in 1823. This paper won the serious consideration of Charpentier in 1836. It was Charpentier who brought the hypothesis to the attention of Louis Agassiz, then living in Switzerland.

In 1840, Agassiz demonstrated the former existence of glaciers in Great Britain and Ireland, and in the same year more fully developed the *glacial theory* in his *Études sur les Glaciers,* which he dedicated to Venetz and Charpentier.

The Geography of Ideas

It should be noted that Perraudin lived in Switzerland, a land where boulders, similar to those in the Brooklyn Botanic Garden, and glaciers were an almost universal feature of the landscape. Agassiz, also, lived all of the early part of his life in Switzerland. Moreover, in Switzerland, one could (in Agassiz's time as now) observe the very process by which the boulders were being transported. The transporting agents there are the valley glaciers of the Alps.

FIG. 9. Glacial Grooves, Inwood Park, Manhattan, New York City. View facing north. (7987)

Agassiz came to America in 1846, and in 1847 he became a professor in Harvard College. During his first year in America, he made his observations of glacial phenomena near Halifax, including erratic boulders and glacial striations.

A Bold Inference

If the boulders of Switzerland are transported by glacial ice, as anyone may actually observe, might it not be possible, or even probable, said Agassiz, that the erratic boulders of North America were also transported by the same agency?

How profoundly one's ideas are affected by his environment! A native of Holland, for example, who had always lived in that country, a resident of the prairies of the United States, or of Australia, could hardly have made even a good guess as to what agency had transported the boulders of Long Island or other parts of North America. If Timothy Dwight, after his keen observation of the Long Island boulders, described above, had lived several years in Switzerland, it is conceivable that he might have drawn the comparisons made by Agassiz and so have become the father of the glacial theory.

But by what ice could the North American boulders have been transported? "Glacial ice hardly seemed probable, for never, within recorded history has the boulder strewn region of America been occupied by glaciers." Yet to Agassiz no other explanation seemed adequate.

The Proof of the Pudding is in the Eating

Well, in Science, when one infers an explanation of an observed phenomenon, the next thing he does is to test his inference or hypothesis. "If the hypothesis, based upon what I have already observed is true," so the reasoning goes, "then certain results should logically follow; certain other facts may be predicted and the prediction will be found to be true." The hypothesis is used as a divining rod to discover additional facts; it is used as a yard stick to measure phenomena already observed; new facts are turned upon the hypothesis like a search light for the purpose of discovering its flaws, or the contrary. Every relevant fact is passed in review in the light of the hypothesis, for the true scientist never

aims to prove the truth of his hypothesis (however much he might be gratified at such a result); his aim is to ascertain whether the hypothesis is *or is not* true. As in religion we have "justification by faith," so in science we have "justification by verification."

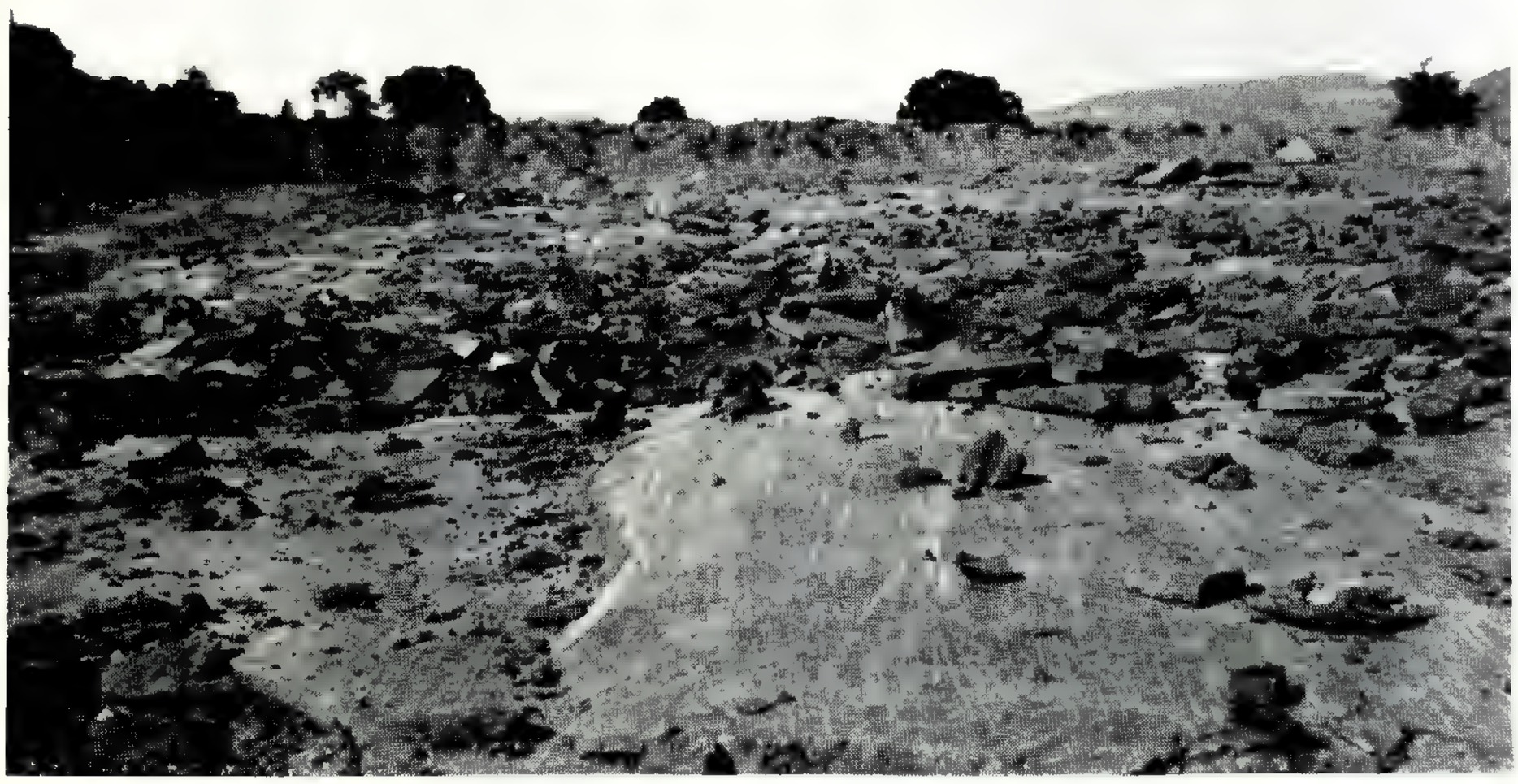

FIG. 10. Glacial striae on one quarter acre of rock surface uncovered during quarry operations. Surface covered with quarried blocks. Several feet of glacial till in the background. One mile southwest of Leonardsville, Unadilla valley, N. Y. Facing northeast. (Photo by Prof. Albert Perry Brigham.)

Sermons in Stones

A multitude of facts is known about the glacial boulders of Switzerland. They are often so large that water as an agent of transportation is definitely excluded; they are of a composition unlike that of the bedrocks of the region where they have come to rest; they do have the same composition as bedrocks in the region whence the transporting glacier is known to have come; they are normally of rounded contour and smooth surface; whereas boulders of disintegration are of the same composition as the *adjacent* bedrock (from which they have been broken off), and mostly are angular and rough (Fig. 10); the ledges over which the glacier has passed have been worn smooth by the friction of the moving ice (Fig. 9); both the boulders and the surface of the underlying bedrock frequently have characteristic parallel

scratches and grooves caused by the rubbing of the transported boulders against the bedrock, and these striations and grooves are parallel, not only to themselves, but also to the direction in which the ice is known to have moved (Figs. 9, 10 and 11).

FIG. 11. Glacial boulder in the Rock Garden, Brooklyn Botanic Garden, showing glacial striae and bronze tablet. (6931)

A Tell-tale Soil

The soil in a glaciated region lies *unconformably* on the underlying bedrock; it was obviously not formed by the disintegration of the latter, but has been brought from elsewhere and deposited where we now find it, taking the place of the original soil of disintegration which had been previously scraped off and removed; the transition from soil to rock is abrupt (Fig. 12).

In a non-glaciated region the transition from bedrock to soil is gradual; the soil was formed by the disintegration of the rock lying beneath, and is hence composed of the same materials as

the latter. The upper surface of the underlying rock is not smooth (Fig. 13).

In a region known to have been occupied by glacial ice the soil deposited directly by and mostly under the ice forms an uneven blanket with hummocks and ridges consisting of a largely unassorted mixture of all sorts of material from fine clay to large boulders. This material is called *till*. Where the ice border advanced or remained stationary for some time it pushed together and built up irregular ridges of loose material, called *moraines*. The ridge on which the Brooklyn Botanic Garden is situated has all the characteristics of a moraine. Gravel, sand, silt, and clay washed out from the ice-border on land, in lakes, or in the sea formed other characteristic deposits.

Hypothesis, Theory, and Fact

To make a long story short, it may be said that the *hypothesis* of a glacial period for a large portion of the North American continent (including Long Island and the site of the Brooklyn Botanic Garden) has been thoroughly tested and verified to such an extent that the hypothesis became first a *theory* (*i.e.*, a largely verified hypothesis), and finally the idea passed from the realm of hypothesis and theory, and is now considered as corresponding to actual *fact*. The influence of Agassiz won the support of others, including the great geologist, Lyell, but the glacial theory was not universally accepted until about sixty years ago.

A Glacier on Long Island

The "back bone" of Long Island, which includes the higher and hilly northern portion of the Botanic Garden, is a moraine. This fact seems first to have been clearly stated by Elias Lewis, Jr., in a letter to Prof. James D. Dana, of Yale College. This letter is published in the *American Journal of Science and Arts,* Volume XIII (3d Series), 1877, page 235. The boulders have been transported by ice from Manhattan Island, New Jersey, southern New York State, and New England, and occasionally all the way from the Adirondacks. In transit they have been rounded, smoothed, and scratched.

FIG. 12. Cut in a glaciated region (Helderberg Mts., Albany Co., N. Y.) showing unconformity between glacial soil and the underlying bedrock, the soil not having been derived from the underlying rock. (Photo by E. J. Stein. Courtesy N. Y. State Museum.) Cf. Fig. 13.

Bronze tablets have been placed on several of the larger boulders, telling their composition and the location of the rock ledges from which they were probably broken off by the glacial ice itself or the forces of weathering, before they started on their long (and shall we say "final") journey to the Rock Garden and boulder bridges of the Brooklyn Botanic Garden (Figs. 11 and 22).

The Time Element

How long a time was required for the transportation of the Botanic Garden boulders from their points of origin to what is now Long Island? This, of course, depends upon two factors: the distance travelled and the rate at which the ice advanced.

Modern glaciers normally move at the rate of 100 to 300 feet a year. We do not know the rate at which the continental ice sheet advanced but, if we assume a yearly rate of say 100 feet, the time required to bring the boulder of Medina Sandstone (No. 18 of our labeled boulders) from its probable point of origin near Albany, about 150 miles, would have been approximately 8000 years.[1] This figure is in close agreement with that arrived at by another method described by Dr. Antevs in the following pages.

FIG. 13. Cut in a non-glaciated region (Jasper County, Georgia), showing surface soil (Iredell loam) derived by the disintegration of the underlying bedrock (Diabase). (Photo by D. D. Long.) Cf. Fig. 12.

The geological history of Long Island is, of course, only an episode or chapter in the glacial geology of North America, which records the events of the last or Quaternary Ice Age on that continent. The Botanic Garden has been fortunate in securing the

[1] 5280 (ft. per mile) × 150 (miles) = 792,000 (ft. from Albany, N. Y., to New York City). 792,000 (feet) ÷ 100 (ft. per year) = 7920 (years).

services of Dr. Ernst Antevs, formerly of the University of Stockholm, who has prepared the following brief popular outline of the geology of that period.

Dr. Antevs was a pupil of Baron De Geer, a student of glacial chronology and founder of the Stockholm Geochronological Institute. Baron De Geer discovered the possibility of using the very fine layers or *varves* of clay deposited during the melting of the Quaternary ice sheet as a geological clock or time-piece. The method is described in the following pages. Dr. Antevs coop-erarted with Baron De Geer in working out the time scale in Sweden, and in 1920 he came to America to study varves in this country for the purpose of correlating American glaciation in time with that of Sweden. During this work he has traced a series of clay layers in the Connecticut Valley which record a period of approximately 4000 successive years, and has been able to chart the successive positions of the frontal edge of the ice as it melted back ("retreated"), and to assign to each position its relative date. He has extended these studies to the Hudson Bay region in Canada.

From the botanical point of view it is interesting to note that the data based on a study of the annual "rings" or layers of growth in the trunks of the Giant Sequoia trees of California, the oldest known living objects, probably will afford a possibility to extend the Swedish late-glacial, postglacial, and recent varve chronologies up to the present time. On the other hand there is no prospect of correlation between American clay records and the growth curves of the Big Trees, for these latter extend back only 3200 years, while the youngest varves measured in Canada are some 10,000 years old. The Sequoia studies have been made by Dr. A. E. Douglass, of the University of Arizona, at Tucson, Dr. Ellsworth Huntington, of Yale University, Dr. Antevs, and others.[2]

[2] On December 18, 1931, Dr. Antevs and Dr. Douglass each received the Research Corporation prize of $2500 and plaque for their scientific contributions to the chronology of the pre-historic and geological past, the two methods above mentioned being considered as the most original and most exact yet devised.

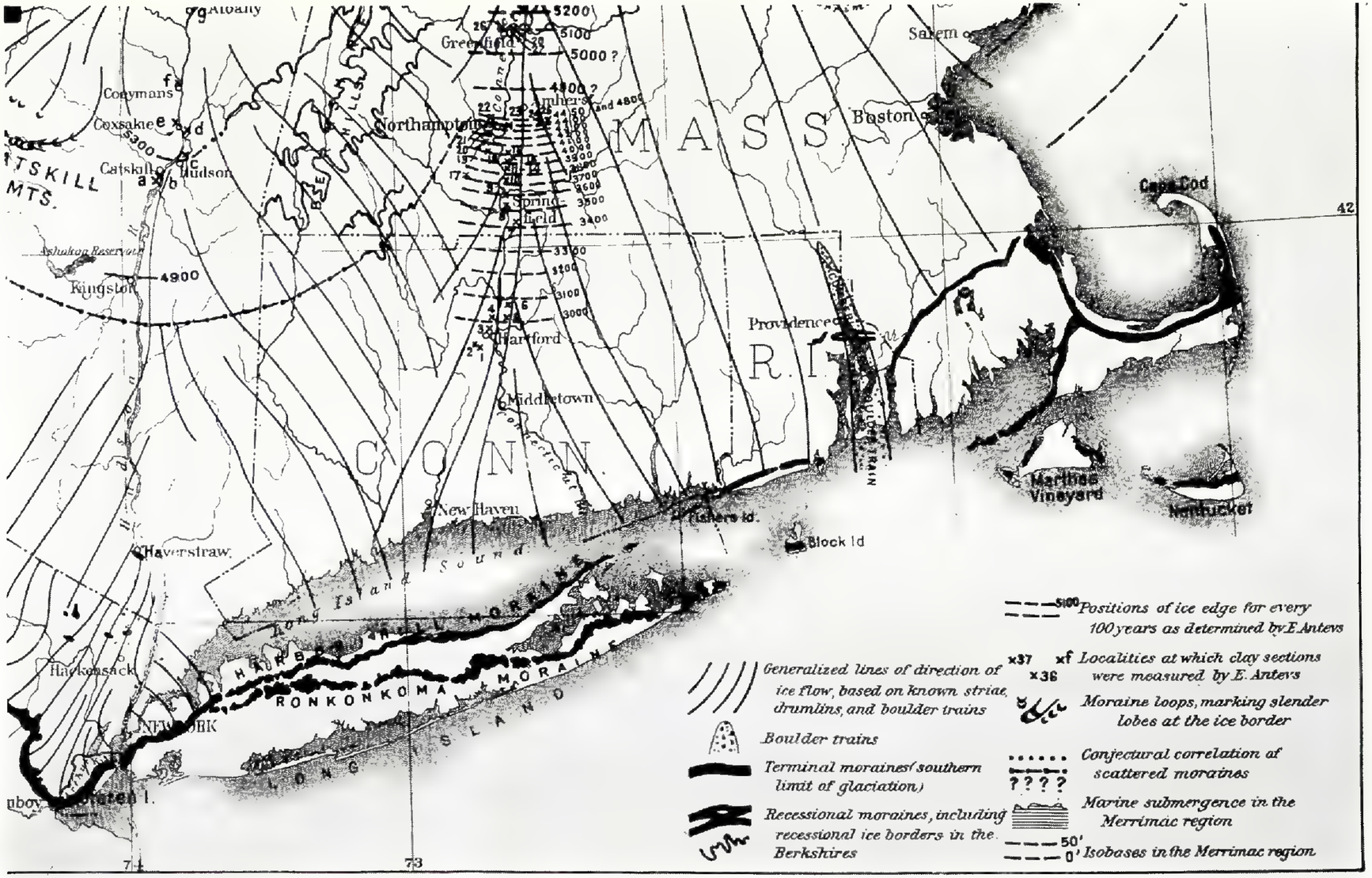

FIG. 14. The recession of the last ice sheet. Terminal moraines and other data. (After Antevs.) (7081)

THE QUATERNARY ICE AGE IN NORTH AMERICA

By Ernst Antevs

First Glaciation

Several hundred thousand years ago the temperature of the earth began to fall and the snow precipitation to increase in medium high latitudes, in North America, especially in the region of Hudson Bay. Snow began to accumulate from year to year in mountains and highlands, forming glaciers such are now to be found in the higher regions of the Rockies, the Alps, and other mountains. The glaciers grew gradually. They filled the valleys and expanded on the lowlands at the foot of the mountains. Here they formed ice fields which, as time passed, became ever larger and thicker. The ice fields grew by accumulation of ice in the mountains and in the central region, and by centrifugal flow caused by the pressure of this ice. They grew also by accumulation of ice along the borders. The growth of the ice was in a sense a *perpetuum mobile,* for since the primary temperature fall had caused formation of glaciers, these in their turn produced a lowering of the temperature. Ultimately four main centers of ice dispersion were formed in North America, viz., in Labrador, in the region west of Hudson Bay, in the region south of Hudson Bay and west of James Bay, and in the Canadian Rockies. The four ice caps coalesced and formed an enormous ice sheet, that finally covered approximately the northern half of the North American continent. It extended from the Atlantic to the Pacific and from the Arctic ocean about to the International Boundary in the west, to south of the Great Lakes, and to Long Island Sound (Fig. 15). The length of time occupied by this enormous growth of the glaciers is not known, but may have been a few tens of thousands of years.

At length, however, the temperature began to rise again and the snowfall over the ice sheets began to decrease. The summer melting of ice, which under the low latitude of New York must have been very great, now equaled the supply, and the ice sheet ceased to grow. Before long ice wastage surpassed nourishment, and the ice border started retreating. Gradually the ice sheet shrank and

perhaps entirely disappeared. The waning of the ice probably required a somewhat longer time than did its formation and growth.

FIG. 15. Map of maximum glaciation of North America. The white spot in Wisconsin is a "driftless area," never covered by glaciers. Solid black areas are mountains covered by local glaciers. (After Lawrence Martin. From Pirsson & Schubert, A Text-Book of Geology. Part II, p. 651.) (6930)

First Interglacial Epoch

Now followed an epoch with climatic conditions much as today, an Interglacial Epoch, so called because of its occurrence between two glacial stages; for at length the temperature again fell and the snowfall increased, ushering in a second glaciation.

Second Glaciation

The conditions and events of the first glaciation were repeated. The ice from Labrador again extended down to southernmost New England or Long Island Sound; and when it reached there a temperature rise checked its growth.

Second Interglacial Epoch

The disappearance of the second ice sheet introduced a long interglacial interval during which the temperature may have become higher than it is in our time. This is suggested above all by rich subfossil remains of plants and animals at Toronto and on the Moose River, near the southern end of Hudson Bay.

Third and Fourth Glaciations

Again history repeated itself. For the third time a huge ice sheet developed and disappeared, and after a new interval a fourth ice sheet formed, waxed, and waned.

Four or Five Glaciations?

The records of some of the events lying hundreds of thousands of years before our time are obscure, especially since each new ice shield swept away almost all traces and deposits of the previous ice. It is therefore not yet surely known, whether there were four or five consecutive ice sheets separated by interglacials.

The Last Glaciation

At any rate, the last ice sheet, be it number four or five, interests us more than any of the others. This ice sheet, called the Wisconsin ice (after the State of Wisconsin), like its predecessors, developed in Labrador, to the south and west of Hudson Bay, and in the Canadian Cordillera. During its greatest extent it covered practically the entire northern half of the North American continent from the Atlantic to the Pacific. It extended down to below the International Boundary in the West, to Cincinnati far below the Great Lakes, to the mouth of the Hudson, and to a line running through central Long Island to Montauk Point, through Block Island, Martha's Vineyard, and Nantucket. It had an area

FIG. 16. Surface geology of the western half of Long Island. Pleistocene (1. Recent; 2. Overwash; 3. 1st Moraine; 4. 2d Moraine; 5. Till (or Boulder Clay); 6. Neocene; 7. Cretaceous; 8. Pre-Cambrian (Gneiss). (From N. Y. State Museum, Geological Map. Southwestern Sheet.) (6928)

of nearly 4.5 million square miles, that is nearly one and a half times that of the United States. The ice was so thick as to completely bury even the highest summits in New England, viz., Mt. Greylock in Massachusetts (3533 feet), Mt. Mansfield in Vermont (4406 feet), Mt. Washington in the White Mountains (6284 feet), and Mt. Katahdin in Maine (5265 feet). In the center of Labrador the ice probably was as much as 14,000 feet or over two and one-half miles thick. In 1931 the Greenland ice sheet was found, by sonic soundings, to average about one mile thick.

To give a further idea of the importance of this glaciation it may be mentioned that there was also a smaller ice sheet in northern Europe covering the Scandinavian countries, the Baltic Basin, northern Germany, and northwestern Russia. There were finally extensive ice-caps and glaciers in the Arctic, the British Isles, the Alps, Asia, southern South America, and elsewhere. The volume of the ice at the climax of the glaciation in *excess* of the existing quantity has been calculated at nearly 8 million cubic miles. We get some idea of the immensity of this quantity when we realize that it corresponds to a water layer 300 to 325 feet thick over all the oceans.

Of course, the water from which the ice was made came from the oceans. Water taken from the sea by evaporation into the air was carried by the winds over the land where it fell as snow and was stored in the growing ice sheets and glaciers. As a result, the level of the sea subsided. Ultimately the ocean surface thus probably stood 300 to 325 feet lower than it does today. The conditions were complicated by vertical movements of the earth's crust, especially depression of the ice-covered areas by the added weight of the ice, but on the whole the shores lay far outside the modern ones. Long Island may have had the shape of a large triangle with a point at either end of the modern island and another about 70 miles south of the present southern shore. Its southwestern boundary was formed by the then Hudson River whose channel is distinctly recognizable, and whose mouth lay some 95 miles southwest of Sandy Hook.

Flora and Fauna Driven Southward

When the ice expanded, northern species of plants and animals were driven southward. They kept the present arrangement in

belts, determined by the climatic conditions; but these zones became narrower the farther southward they were removed. The ice edge in New Jersey and elsewhere, consequently, was bordered by a belt of plants and animals, such as now occur on the tundras or barren grounds of the north. The plants included prostrate willows, Lapland Rhododendron, *Diapensia lapponica,* and sedges.

FIG. 17. Face of Brother John's Glacier. (Photo No. 230,786 by Donald B. MacMillan. Courtesy of American Museum of Natural History.)

Among higher animals there were reindeer and musk ox, of which the last mentioned is now entirely confined to arctic North America and to Greenland.

During the period of glaciation, also, variation and the struggle for existence continued, the latter with exceptional intensity, in the narrow, crowded, and shifting belts, resulting in the survival of only the most adaptable forms. Thus new species arose—the more or less modified descendants of the forms that started to migrate southward with the advance of the ice. This gave rise to a flora and fauna containing new elements.

As the ice edge finally receded northward this (partly new) arctic and sub-arctic flora and fauna migrated with it, and became established over the region previously covered by the ice. A certain percentage of the present local flora plants are the descendants of these forms.

For a brief period just following the final recession of the ice it seems probable that there was little vegetation on Long Island. Among the northern forms that finally became established were the Harebell or Blue Bells of Scotland (*Campanula rotundifolia*), the Cloudberry (*Rubus Chamaemorus*) and the Crowberry (*Empetrum nigrum*). These are rare on Long Island, but common farther north.

In the herbarium of the Broklyn Botanic Garden are two specimens of the Cloudberry or Mountain Bramble (*Rubus chamaemorus*) collected in a bog near Montauk Point, Long Island, in 1908 by Dr. William C. Braislin, of Brooklyn. As one passes northward from Long Island, this plant is not found again south of New Hampshire. It ranges from Labrador and Newfoundland to New Hampshire and west to British Columbia and Alaska. Being an arctic or sub-arctic bog plant, it found a congenial bog environment in this extreme southern outpost of its range, telltale evidence of the glacial period.

The Ice Age and Plant Geography

It is known to all students of plant geography "that, notwithstanding the comparative proximity of Japan to Western North America, fewer of its species are represented there than in far distant Europe. Also,—showing that this difference is not owing to the separation by an ocean,—that far more Japanese plants are represented in Eastern North America than in either." This quotation is from the well known American botanist, Asa Gray,[1] and is based upon his tabulation of the distribution of Japanese plants and their nearest allies in the Northern temperate zone. If we regard the *identical* species only, in the several floras (Europe, Central and Northern Asia, Japan, Western North America, and

[1] Gray, Asa. *Observations upon the relations of the Japanese flora to that of North America*, etc. *Botanical Memoirs. Mem. Amer. Acad. Arts and Sciences* 6: 377–452. Boston and Cambridge. April 25, 1859.

Eastern North America), "the preponderance is equally against Western as compared with Eastern North America, but is more in favor of Europe . . . so geographical continuity favors the extension of identical species; but still Eastern North America has more in common with Japan than Western North America has." Gray then enumerates 56 "peculiar species which Japan possesses in common with America, of which 34 inhabit Western, and 41 Eastern North America. And 15 are Western and not Eastern; 22 Eastern and not Western; and 19 common to both sides of the continent."

Dr. Gray then notes that the existence of *identical* species in widely separated districts indicates "former continuity, migration or interchange, basing his conclusion on Darwin's (then recently announced) theory of organic evolution, which teaches that individuals of the same kind are descendants from a common stock.[2] He then quotes a remark of the botanist Bentham that the interchange of the floras of the New World and the western part of the Old World suggested "an ancient continuity of territory between America and Asia, under a latitude, or at any rate with a climate more meridional than would be effected by a junction through the chains of the Aleutian and Kurile Islands."

Gray then gives his masterful analysis of the problem and his conclusion that no such imaginary landbridge as Bentham postulated is necessary, but that the facts of plant distribution above noted may be naturally and simply explained by the events preceding, during, and following the glacial epoch. In the following paragraphs the language, even when quotation marks are not used, is largely that of Asa Gray.

The climatic and other conditions in the geological age immediately preceding the Ice Age were such that "the temperate floras of America and Asia must then have been conterminous, and therefore have commingled, as conterminous floras of similar climate everywhere do."

As the glacial epoch came slowly on, carrying glacial ice and arctic climate down nearly to the latitude of Ohio, the change

[2] Darwin's *Origin of Species* (Nov. 24, 1859) had not been published when Gray wrote this. He cites the now famous preliminary papers of Darwin and Wallace, "*On the tendency of species to form varieties," etc.* Proceedings, Linnean Society. Vol. III (Zoology): p. 45. 1858.

was so gradual that it did not destroy the temperate flora, or at least not those forms enumerated by Gray in his table as existing species. "These and their fellows, or such as survived, must have been pushed on to lower latitudes as the cold advanced, and between them and the ice there was doubtless a band of subarctic and arctice vegetation,—portions of which, retreating up the mountains as the climate ameliorated and ice receded, still scantily survive upon our highest Alleghenies, and more abundantly upon the colder summits of the mountains of New York and New England:—demonstrating the existence of the present arctic alpine vegetation during the glacial area; and that the change of climate at its close was so gradual that it was not destructive of vegetable species."

"As the temperature rose, and the ice gradually retreated, the surviving temperate flora must have returned northward *pari passu,* and—which is an important point—must have advanced much farther northward, and especially northwestward, than it now does; so far, indeed, that the temperate floras of North America and Eastern Asia, after having been for long ages most widely separated, must have become a second time conterminous."

All the evidence shows that the temperature differences between the two continents before the ice age were very nearly the same as now, the isothermal lines having in earlier times turned northward on our eastern, and southward on our northwest coast, as they do today. This fact of similarity of climates and the fact that the interchange of species took place in high northern latitudes, "are points which go far towards explaining why Eastern North America, rather than Oregon and California, has been mainly concerned in this interchange."

The descendants of the forms that became stranded at or near the summits of the higher peaks remain today as arctic-alpine "islands" of plant and animal life, having affinities with forms found elsewhere only in more northern latitudes.

The summit of Mount Washington (altitude 6284 ft. U. S. G. S. bench mark) and other peaks of the Presidential Range of the White Mountains possess today an "island" of vegetation and animal life related to the plants and animals of Labrador and Greenland, a thousand miles away, but not related to the flora and fauna on the lower slopes of the same mountains and the sur-

FIG. 18. Front of Sperry Glacier, Glacier National Park. Photo by William C. Allen, U. S. Geol. Survey, August, 1928. Shows lower end of glacier and the inner terminal moraine on top of which the ice rested in 1913. (Courtesy of Dr. George Otis Smith.)

rounding territory. Among the arctic or sub-arctic plants on these peaks are, for example, the Lapland Rhododendron (*R. lapponicum*), alpine willows (*Salix phylicifolia* and others), the Greenland Sandwort (*Arenaria groenlandica*), dwarf Birch, *Diapensia lapponica,* arctic lichens, and many other forms (about 55 in all), only found on some high mountains between Mount Washington and Labrador.

Outside the tundra zone, that may have been rather narrow, there came sub-arctic forests with birch, alder, spruce and fir and associated flora and fauna.

Deposits Formed by the Ice

Ronkonkoma Moraine

As mentioned above, when the edge of the last ice sheet had reached a line extending from Manhasset eastward to Montauk Point a rise of temperature set in. Wastage of ice now equalled supply from the north, and the ice border became stationary. Streams of melt-water furrowed the surface of the ice and issued from beneath the ice. Boulders, cobbles, gravel, sand, silt, and clay that have been embedded in the ice melted out. The coarse material and part of the fine material was dumped on the spot. With material pushed together by slight movements of the ice edge it formed a more or less conspicuous irregular ridge consisting of small crests, cones, hummocks, and depressions. The ridge is from half a mile to about three miles wide and rises at many places 100 to 150 feet above the adjacent plain. This is the Ronkonkoma Moraine, so called for Lake Ronkonkoma in the central part of the island (Fig. 14).

The bulk of the sand and part of the fine gravel were deposited outside the moraine. Soaked with melt-water the sand flowed out, gradually building up (during deposition) and reworking the gently sloping outwash plains or frontal aprons that extend all the way to the southern shore of the island.

During movements of the ice sheet, blocks of ice were frequently dislodged from the solid ice mass to be buried beneath sand and gravel. Just as sawdust checks the melting of ice in a modern ice-house, so the sand could preserve the underlying ice blocks until the continuous ice edge had withdrawn from the vicinity.

When the buried ice finally disappeared under the sun's rays the covering material sank, and a depression of more or less rounded outlined resulted (Fig. 21). The basin of Lake Ronkonkoma is such a kettle.

The Ronkonkoma Moraine and its deposits do not occur at the surface west of Manhasset being here covered by the younger Harbor Hill Moraine and its associated beds, to be treated below.

Harbor Hill Moraine

After building the Ronkonkoma Moraine the ice receded. When its border had reached about the present northern shore of Long Island it halted and readvanced forming another morainic ridge, the Harbor Hill Moraine. From the Narrows to Manhasset the readvancing ice border pushed beyond its previous outermost position, overriding the northern part of the Ronkonkoma Moraine and associated beds. Prospect Park and the Brooklyn Botanic Garden are located on the Harbor Hill Moraine.

East of Manhasset the younger moraine lies inside or north of the older moraine following for the most part the northern shore of the island and running out in the northern horn of eastern Long Island at Orient Point, and reappearing eastward at Plum Island and Fisher's Island.

On the whole, the Harbor Hill Moraine contains much more unassorted material, much more boulders and stones (so called till) than does the Ronkonkoma Moraine. In western Long Island, where the forward motion of the ice had been considerable, nearly all the material is stony and bouldery till. As noted in the first part of this Guide, there are many boulders in the moraine in Brooklyn Botanic Garden.

Here in western Long Island the moraine consists of rather large, regular hills with fairly gentle slopes and relatively regular, shallow depressions. It has a width of about a mile. It rises from about 100 feet altitude on the Narrows to some 250 feet southwest of Manhasset Bay, and is from 80 to 100 feet thick.[3]

[3] The elevation of the sidewalk at the entrance gate on Eastern Parkway, at the north end of the Garden, is 165 feet. The elevation of the sidewalk at the Richard Young gate, near the south end of the Garden on Flatbush Ave., is approximately 80 feet—a difference of 85 feet in a distance of 3300 feet. The elevation of Boulder Hill (in the Garden), at the big boulder, is 138 feet, or 23 feet above that of the Laboratory Plaza.

FIG. 19. Surface of the Harbor Hill moraine in the region which is now partly the northern part of Brooklyn Botanic Garden. View looking east from the southeast corner of Mt. Prospect Reservoir, 1860. (Egbert L. Viele. First Ann. Rept. Prospect Park, Brooklyn, 1861.) (2423)

Also in front of the Harbor Hill Moraine is an extensive, though rather thin, cover of fine gravel and sand deposited by water flowing from the melting ice. In the northern part of the Botanic Garden, close to the moraine, the fine gravel contains boulders. South of Brooklyn this so called wash plain extends down to the bays north of Coney Island. It is fan-shaped in outline with the handle near the Botanic Garden, where the main stream issuing from the ice had its mouth.

The length of time that the ice border remained at the two moraines is not known. Nor is the time occupied by the recession from the first moraine to beyond the second known. However, if we may judge from other moraines, whose rate of formation has been determined it seems probable that each moraine repre-

FIG. 20. Glacial sand plain with intercalated till bed near the top. West side of Hempstead Harbor, Long Island. The glacial boulders were probably dropped from floating icebergs while the sand and till were being deposited. The *talus* (Latin, ankle) over the foot of the embankment has been deposited as a series of alluvial fans. (7989. From Barton W. Stone Collection, Columbia University. Courtesy of Prof. A. K. Lobeck.)

sents several hundred years and the two moraines, together with the intervening retreat, about 2000 years.

How Long Ago Were the Deposits in Brooklyn Botanic Garden Formed?

The question, "How long ago?", is one of the first to be put to a geologist by the layman; but it is one of the most difficult to answer. For dating events related to the last glacial epoch a finely laminated clay is of special importance. This clay, showing layers resembling annual rings in wood, was formed in fresh water lakes in front of the melting ice sheets. It was formed of water-borne material coming directly from the ice. Because water is heaviest at a temperature of 39.2° F. the ice-cold (32° F.) melt-water was lighter than the bulk of the lake water. It therefore rose to the surface, when discharged into the lake. In doing so it brought along part of the mud (silt and clay) it had carried from the glacier. Being too heavy to remain in suspension the larger grains, *i.e.*, the silt and the coarser clay, soon sank to the lake bottom. The finest clay, on the other hand, being extremely light, was unable to settle as long as the water was in motion. First during the quietness of the following winter did it slowly sink to the bottom. In this way a silty layer was formed in summer and a fine clay layer in winter, the two indicating the year. The layer-pair, the annual deposit, is called a *varve*.[4] These clay varves have been used as a basis for a chronology of the time of waning of the last ice sheets. The studies carried out so far suggest that the retreat of the ice front from Long Island to central Labrador, that is, the total disappearance of the ice, took from 25,000 to 30,000 years.

By another laminated clay also indicating years, though formed under entirely different conditions on the Swedish coast of the Gulf of Bothnia, the time since the practical disappearance of the

[4] Antevs, Ernst. The recession of the last ice sheet in New England. Amer. Geogr. Soc., Research Ser. No. 11. New York, 1922.

Antevs, Ernst. Retreat of the last ice sheet in Eastern Canada. Geol. Survey of Canada, Mem. 146. Ottawa, 1925. Antevs, Ernst. The last glaciation. Amer. Geogr. Soc. Research Ser. No. 17. New York, 1928.

Antevs, Ernst. Late-glacial correlations and ice recession in Manitoba. Geol. Survey of Canada, Mem. 168. Ottawa, 1931.

European ice sheet has been determined. This is about 8700 years. The probable time that has elapsed since the last ice sheet stood on Long Island is thus found to be about 35,000 years. Historically seen, this is very long ago, geologically seen, it was only yesterday.

The Quaternary Period

These four or five glaciations with intervening interglacial epochs belong to the Quaternary Period which still prevails. Together the glaciations form the Quaternary Ice Age or the Pleistocene. The time of waning of the last ice sheets is the late-glacial age, and the time since the practical disappearance of the ice sheets is called the postglacial age.

Will there be a new glaciation in the future? Since there seem to have been four or five glaciations separated by epochs as warm as or warmer than the present, it is not out of place to ask whether or not another glaciation is to be expected in the future. Positive answer cannot be given, but it is very possible that in some 50,000

FIG. 21. Kettlehole in the Ronkonkoma moraine at Culloden Point, Long Island, September, 1920. The amount of water in the hole varies with the season. (Photo by Barrington Moore. From Brooklyn Botanic Garden Memoirs, Vol. II.)

years a new ice sheet will irresistibly push its way as far south as its predecessors, deleting the work of man on its way and building a new terrain, on the surface of which, after that ice retreats, there may develop modified floras and faunas, new races of men, and new civilizations.

COMPOSITION AND SOURCES OF THE BOTANIC GARDEN BOULDERS

As already stated in this GUIDE, one of the features of erratic boulders that arrested the attention of early observers was the fact that they were of different composition from the underlying bedrock. Where the terrain was wholly of glacial origin, as in the case of most of Long Island, there was, of course, no bedrock, but in such cases it was noted that the boulders had the composition of bedrock to the north.

A technique has been perfected whereby sections of rock can be prepared so thin that they may be viewed under the microscope with transmitted light. Studies made in this way enable one to ascertain the composition of a rock sample, and to compare one sample with another, with great accuracy. Through the cooperation of Dr. Robert Balk, professor of geology in Hunter College, New York City, samples were taken from about thirty of the larger or otherwise more interesting boulders in the Botanic Garden and studied microscopically, as just described. Comparisons were then made with the already known composition of outcrops of bedrock north of Long Island. In this way it has been possible to determine, with a fair degree of accuracy, the general location of the ledges of which our boulders were formerly a part and from which they were picked up by the southward moving continental ice sheet, carried to the southern edge of the ice, and there deposited, to become ultimately a geological enigma, a source of troublesome bother in grading operations, a valuable feature of the landscape, building material for rock garden and bridges, and the subject of this GUIDE and of innumerable other geological treatises.

Through the generosity of Mr. Edward C. Blum, president of our Board of Trustees, a fund was provided for the casting of

twenty-eight bronze tablets and the fastening of them to as many boulders in the Botanic Garden.

The great diversity in the composition and sources of these boulders is emphasized by the fact that, of these twenty-eight, sixteen are of unlike composition and their sources are even more

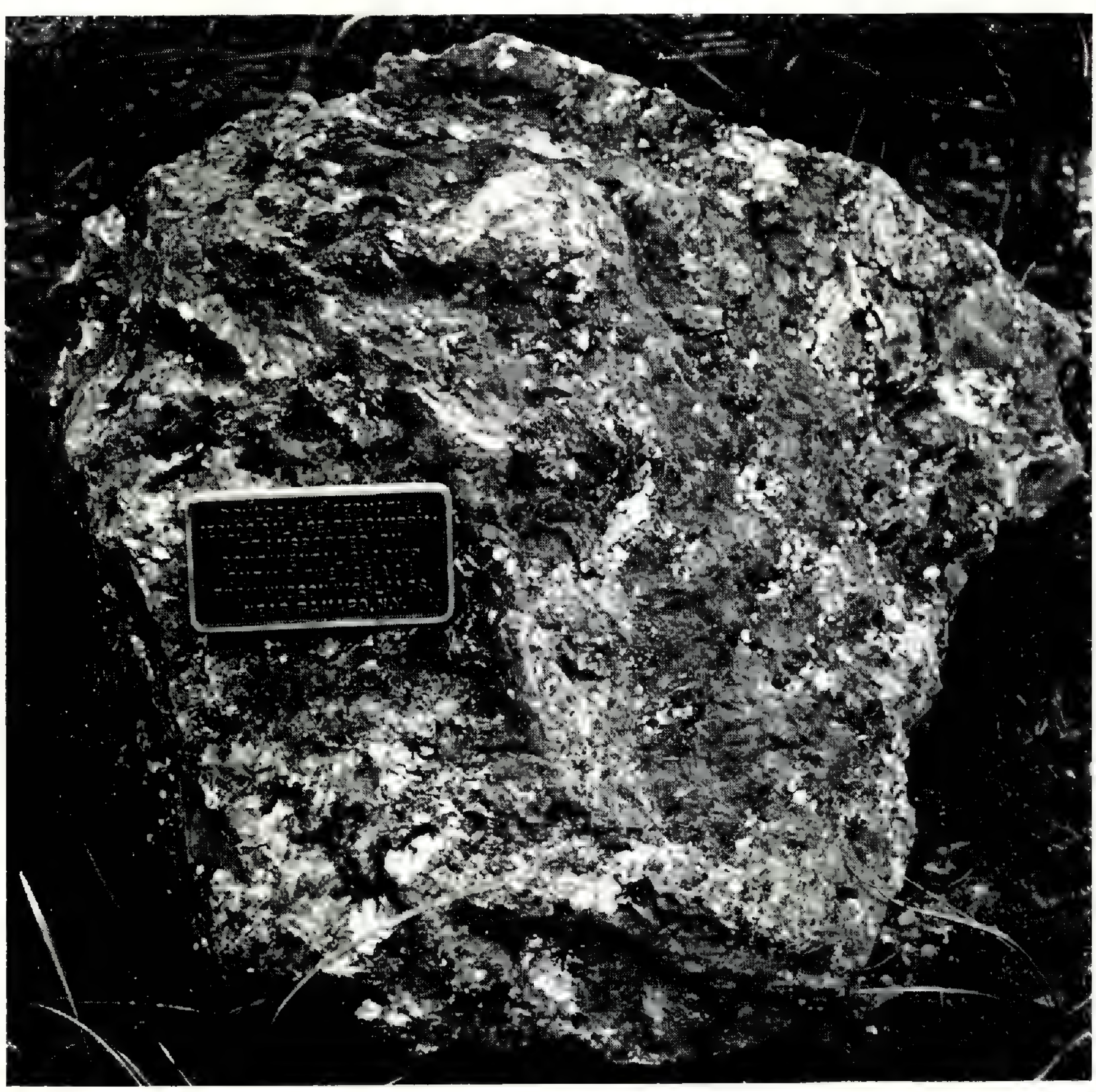

FIG. 22. Boulder of Pegmatite, in the Rock Garden. (Number 10 of the labeled boulders.) To illustrate the bronze tablets. (7992)

diverse. The shortest journey traveled appears to be that of the white marble boulder, No. 15, which came from the northern part of Manhattan Island (Inwood) or from Spuyten Duyvil, just across the Harlem River—approximately 15 miles. The longest journey is that of the Syenite-Granite boulder, No. 23, which was brought by the glacial ice from the southeastern Adirondack

Mountains—approximately 250 miles. The longest transportation of erratic boulders known in North America is 650 to 700 miles (see compilation in Antevs: *The last glaciation,* page 66).

Following is the reading matter on the twenty-eight bronze tablets. Each tablet bears a number corresponding to that given below.

Reading Matter on the Twenty-eight Bronze Tablets

No. 1
Boulder of Diabase
Geological Age, Triassic
Transported by Continental Glacier
During the Ice Age
From Palisades, between Hoboken and Englewood

No. 2
Boulder of Olivine Diabase
Geological Age, Triassic
Transported by Continental Glacier
During the Ice Age
From the Palisades

No. 3 (Two alike)
Boulder of Diabase
Geological Age, Triassic
Transported by Continental Glacier
During the Ice Age
From near Haverstraw, N. Y.

No. 5
Boulder of Diabase
Geological Age, Triassic
Transported by Continental Glacier
During the Ice Age
From near Haverstraw, N. Y.

No. 6
Boulder of Micaceous Gneiss
Geological Age, Precambrian
Transported by Continental Glacier
During the Ice Age
From Ramapo Mts., N. Y.

No. 7
Boulder of Pegmatite
Geological Age, Precambrian
Transported by Continental Glacier
During the Ice Age
From Hudson Highlands, near Ramapo, N. Y.

No. 8 Boulder of Diorite Gneiss
Geological Age, Precambrian
Transported by Continental Glacier
During the Ice Age
From Hudson Highlands

No. 9 Boulder of Gneissoid Syenite
With Pegmatite Vein
Geological Age, Precambrian
Transported by Continental Glacier
During the Ice Age
From Hudson Highlands, near Ramapo, N. Y.

No. 10 Boulder of Pegmatite
Geological Age, Precambrian
Transported by Continental Glacier
During the Ice Age
From Hudson Highlands, near Ramapo, N. Y.

No. 11 Boulder of Diabase
Geological Age, Triassic
Transported by Continental Glacier
During the Ice Age
From near Englewood, N. J.

No. 12 Boulder of Pegmatite
(Rich in White Mica)
Geological Age, Precambrian
Transported by Continental Glacier
During the Ice Age
From Hudson Highlands

No. 13 Boulder of Fine-grained Diabase
Geological Age, Triassic
Transported by Continental Glacier
During the Ice Age
From a Vein in the Palisades

No. 14 Boulder of Olivine-Enstatite-Diabase
Geological Age, Triassic
Transported by Continental Glacier
During the Ice Age
From Palisades near Haverstraw, N. Y.

No. 15 Boulder of White Marble
Geological Age, Cambro-Ordovician (?)
Transported by Continental Glacier
During the Ice Age
From northern Manhattan or Spuyten Duyvil

No. 16 — Boulder of Cherty Limestone
Geological Age, Cambro-Ordovician
Transported by Continental Glacier
During the Ice Age
From east of Poughkeepsie

No. 17 — Boulder of Reddish Hornstone
(Metamorphosed by Diabase)
Geological Age, Triassic
Transported by Continental Glacier
During the Ice Age
From West of Haverstraw

No. 18 — Boulder of Medina Sandstone
Geological Age, Lower Silurian
Transported by Continental Glacier
During the Ice Age
From Stephentown, southeast of Albany

No. 19 — Boulder of Sandstone
Geological Age, Triassic
Transported by Continental Glacier
During the Ice Age
From near Paterson, N. J.

No. 20 — Boulder of Manhattan Schist
Geological Age, Ordovician
Transported by Continental Glacier
During the Ice Age
From Manhattan Island

No. 21 — Boulder of Medina Arkose
Geological Age, Lower Silurian
Transported by Continental Glacier
During the Ice Age
From Stephentown, southeast of Albany

No. 22 — Boulder of Serpentine
Geological Age, Precambrian
Transported by Continental Glacier
During the Ice Age
From near Peekskill

No. 23 — Boulder of Syenite-Granite
(Garnet Bearing)
Geological Age, Precambrian
Transported by Continental Glacier
During the Ice Age
From southeastern Adirondacks

No. 24 — Boulder of Pegmatite
(Crystals of Plagioclase)
Geological Age, Precambrian
Transported by Continental Glacier
During the Ice Age
From near West Point

Nos. 25–27 — Glacial Boulder
(Triassic Diabase)
Showing Glacial Scratches

No. 28 — Boulder of
Volcanic Breccia
Triassic Diabase-Basalt
Transported by the
Continental Glacier
During the Ice Age
From Northern New Jersey

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The Botanic Garden is open free to the public daily from 8 a.m. until dusk; on Sundays and Holidays it is open at 10 a.m.

Entrances.—On Flatbush Avenue, near Empire Boulevard and near Mt. Prospect Reservoir; on Washington Avenue, south of Eastern Parkway and near Empire Boulevard; on Eastern Parkway, west of the Museum Building.

The street entrance to the Laboratory Building is at 1000 Washington Avenue, opposite Crown Street.

To Assist Members and others in studying the collections the services of a docent may be obtained. This service is free of charge to *members of the Botanic Garden;* to others there is a charge of 50 cents per person. Arrangements must be made by application to the Curator of Public Instruction at least one day in advance. No parties of less than six adults will be conducted.

To Reach the Garden take Broadway (B.M.T.) Subway to Prospect Park Station; Interborough Subway to Eastern Parkway-Brooklyn Museum Station; Flatbush Avenue trolley to Empire Boulevard; Franklin Avenue, Lorimer Street, or Tompkins Avenue trolleys to Washington Avenue; St. John's Place trolley to Sterling Place and Washington Avenue; Union Street or Vanderbilt Avenue trolleys to Prospect Park Plaza and Union Street. By Automobile from points on Long Island take Eastern Parkway west and turn left at Washington Avenue; from Manhattan, take Manhattan Bridge, follow Flatbush Avenue Extension and Flatbush Avenue to Eastern Parkway, turn left following Parkway to Washington Avenue; then turn right.

BROOKLYN BOTANIC GARDEN
PUBLICATIONS

RECORD. Established, January, 1912. An administrative periodical issued quarterly (1912–1928); bimonthly beginning with 1929. Contains, among other things, the *Annual Report* of the director and heads of departments, special reports, announcements of courses of instruction, seed list, guides, miscellaneous papers, and notes concerning Garden progress and events. Free to members of the Garden. To others $1.50 a year. Circulates in 59 countries.

MEMOIRS. Established, July, 1918. Published irregularly. Circulates in 47 countries.

Volume I. *Dedication Papers:* comprising 33 scientific papers presented at the dedication of the laboratory building and plant houses, April 19–21, 1917. 521 pages. Price $3.50, plus postage.

Volume II. The vegetation of Long Island. Part I, The vegetation of Montauk: A study of grassland and forest. By Norman Taylor, June 11, 1923. 108 pages. Price $1.00, plus postage.

Volume III. Vegetation of Mount Desert Island, Maine, and its environment. By Barrington Moore and Norman Taylor, June 10, 1927. 151 pages. Price $1.60.

CONTRIBUTIONS. Established, April 1, 1911. Papers originally published in periodicals, reissued as "separates," without change of paging, and numbered consecutively. Twenty-five numbers constitute one volume. Price 25 cents each, $5.00 a volume. Circulates in 34 countries.

61. Inheritance of smut resistance in hybrids of early Gothland and Monarch oats. 13 pages. 1931.

62. Physiologic races of Ustilago levis and U. avenae on red oats. 00 pages. 1932.

63. Inheritance of resistance to loose and covered smut in a hybrid of Early Gothland and Victor oats. 10 pages. 1932.

64. Inheritance of resistance to loose and covered smut in hybrids of Hull-less with Early Gothland and Monarch oats. 28 pages. 1932.

LEAFLETS. Established, April 10, 1913. Published weekly or biweekly during April, May, June, September, and October. The purpose of the *Leaflets* is primarily to give announcements concerning flowering and other plant activities to be seen in the Garden near the date of issue, and to give popular, elementary information about plant life for teachers and others. Free to members of the Garden. To others, fifty cents a series. Single numbers 5 cents each. Circulate in 28 countries.

GUIDES to the collections, buildings, and grounds. Price based upon cost of publication. Issued as numbers of the *Record;* see above.

Guide No. 5. The Rock Garden. 28 illustrations. Price, 35 cents. By mail, 40 cents.

Guide No. 6. Japanese Potted Trees (*Hachinoki*). 11 illustrations. Price, 35 cents. By mail, 40 cents.

SEED LIST. (*Delectus Seminum*) Established, December, 1914. Since 1925 issued each year in the January number of the RECORD. Circulation includes 160 botanic gardens and institutions located in 40 countries.

AMERICAN JOURNAL OF BOTANY. Established, January, 1914. Published, in coöperation with the BOTANICAL SOCIETY OF AMERICA, monthly, except during August and September. Subscription, $7.00 a year. Circulates in 53 countries.

ECOLOGY. Established, January, 1920. Published quarterly in coöperation with the ECOLOGICAL SOCIETY OF AMERICA. Subscription, $4.00 a year. Circulates in 48 countries.

GENETICS. Established, January, 1916. Bimonthly. Subscription, $6.00 a year. Circulates in 37 countries.

BROOKLYN BOTANIC GARDEN RECORD

VOL. XXI JULY, 1932 NO. 4

THE STORY OF FOSSIL PLANTS

GUIDE TO THE TRANSPARENCIES IN CONSERVATORY HOUSE No. 2

GUIDE No. 8

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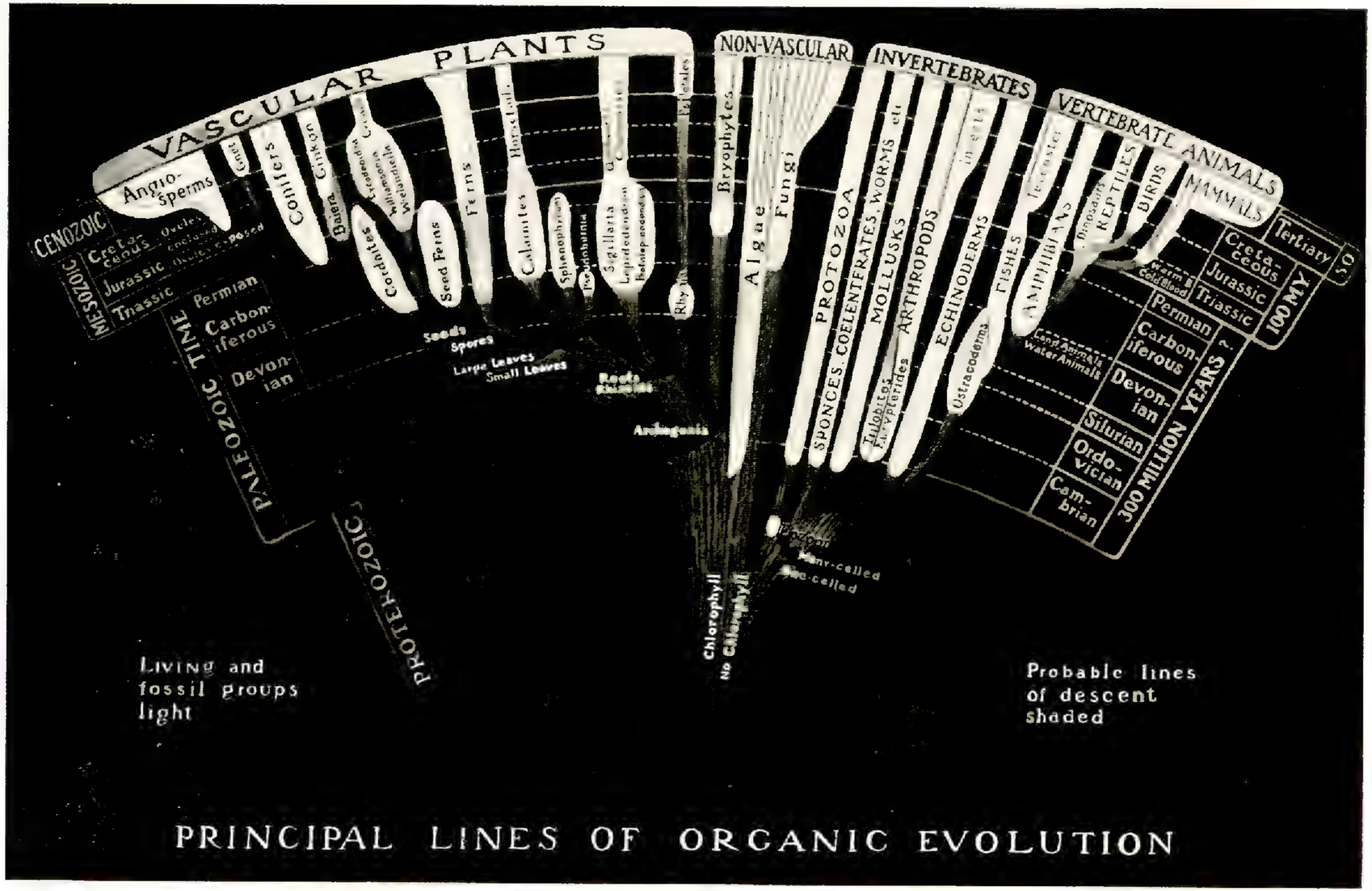
VASCULAR PLANTS
NON-VASCULAR
INVERTEBRATES
VERTEBRATE ANIMALS
CENOZOIC
MESOZOIC
PALEOZOIC
PROTEROZOIC
TIME
Tertiary
Creta-ceous
Jurassic
Triassic
Permian
Carbon-iferous
Devon-ian
Silurian
Ordo-vician
Cam-brian
100 MY
300 MILLION YEARS
Angio-Sperms
Conifers
Ginkgo
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Bryophytes
Algae
Fungi
PROTOZOA
PORIFERA
COELENTERATES
WORMS
MOLLUSKS
ARTHROPODS
ECHINODERMS
Ostracoderms
FISHES
AMPHIBIANS
REPTILES
BIRDS
MAMMALS
Seeds
Spores
Large Leaves
Small Leaves
Roots
Archegonia
Chlorophyll
No Chlorophyll
Many-celled
One-celled
Land Animals
Water Animals
Warm Blooded
Living and fossil groups light
Probable lines of descent shaded
PRINCIPAL LINES OF ORGANIC EVOLUTION

FIG. 1

BROOKLYN BOTANIC GARDEN RECORD

VOL. XXI JULY, 1932 NO. 4

THE STORY OF FOSSIL PLANTS

GUIDE TO THE TRANSPARENCIES IN CONSERVATORY HOUSE NO. 2*

By Edward W. Berry

Professor of Palcontology

The Johns Hopkins University

The earth has been recording its autobiography for millions of years in the rocks of its crust, the estimates from the study of radioactive minerals giving figures somewhere between 1500 and 2000 million years since it was of the size and form that it is today. The study of this autobiography is the science of geology, and it needs but understanding wedded to imagination to make much of this vast history intelligible. Through at least two thirds of these eons life has been present and has contributed its records to the sedimentary rocks.

Almost everyone is familiar with some phases of evolutionary discovery among animals, such as has been worked out for the horse, camel, or elephant, but that plants have a similar evolution is hardly realized. Most people, if they give it a thought, think that the earth was always mantled with verdure as it is at present. They may know that all animal life is dependent on the organic food which plants, with the aid of the sun's rays, elaborate from inorganic substances, but this does not mean to them that plants must be older than animals, nor do they realize that the evolution of the flowering plants conditioned the evolution of warm blooded animals, or that it was the concentrated food stuffs in the seeds of flowering plants which made agriculture and hence human civilization possible.

* A "Note on the Preparation of the Transparencies" may be found on the last page.

In connection with its exhibit illustrating, with living plants, the probable course of plant evolution, the Brooklyn Botanic Garden has installed, in Conservatory House No. 2, the series of eight transparencies (shown in Figures 1–8). These depict some of the myriads of extinct plants that have moved across the world's stage, and summarize the main features of the evolution of the plant world.

1. Principal Lines of Organic Evolution *

As in the beginnings of human history we depend upon traditions crystallized into mythology, so in tracing backward the various plant stocks we reach a point where facts fail us, and we are forced to speculate on the earlier stages of plant evolution which are forever hidden from us.

The relations of the principal groups of both plants and animals are set forth in the first transparency, which aims to summarize what we know and what we surmise. In this great tree of life the known is shown in white and that which is surmised is shaded. More than half of geological time had passed before there was any abundance of fossils in the rocks, and by that time not only had life evolved into plants and animals, but nearly all the groups of invertebrate animals had already been differentiated, and the ancient waters contained a great variety of algae.

Students of fossil plants differ widely in their views regarding the time when plants first came out of the water and became adapted for living on the land. The problem is made difficult by the fact that land plants have not been found fossil in any certainly recognizable forms until the comparatively late Devonian period, as shown on the diagram. This contrast between the early animal and plant histories is due to the marine habits of the invertebrate groups and to the fact that most of the earlier preserved sediments are of marine origin and consequently would fail to preserve any abundance of land forms even if they were in existence.

We may, therefore, formulate a brief paragraph on the beginnings of plant life, unhampered by facts, and guided by what seem to be the probabilities. Certainly the beginnings of life were unicellular and not multicellular. We believe that these first or-

* The numbered headings, centered on the pages, refer to the full page illustrations of this Guide.

ganisms may have obtained their energy for building up organic from inorganic materials, much as certain modern bacteria do, by the oxidation of carbon, nitrogen, sulphur, or iron by what is called *chemosynthesis,* and that what might be called the first stage of evolution preceded the evolution of chlorophyll or "leaf green," the possession of which distinguishes plants from animals and enables the former to utilize the energy of the sun, by *photosynthesis,* to obtain carbon from the carbon dioxide of the air, and build complex organic starches and sugars from inorganic materials.

Once chlorophyll was evolved we would have plants much like the Cyanophyceae or blue-green algae, which would serve as a starting point for the more complex green plants. Meanwhile the evolution of metatrophic bacteria, which derive their carbon from other organisms, would forever prevent any subsequent origin of life, and effectually answer the question so often raised: "If the organic originated from the inorganic once why can it not do so repeatedly?"

The evolutionary history of plants may be divided, then, into a first and hypothetical pre-chlorophyllic or Eophytic stage, and a second and entirely objective chlorophyllic stage. The latter would, at first, constitute what might be called an algae substage, since it is clear from all lines of evidence, as well as from what we know of geological history, that all land plants were derived from algal ancestors.

2. Algae

The mutual relations among the various classes of algae are much too abstruse to be set forth in this connection, but we can visualize a progression from unicellular to multicellular and from planktonic (floating) to benthonic (deep-water or bottom) habits.

The nature of the algal plant body, without a cuticularized epidermis (*cutin*) and without mechanical tissue (*lignin*), results in the total oxidation of algae before they can be covered by sediments and preserved as fossils; or, if they happen to be so preserved, the fossil is a mostly undecipherable impression from which little of its true nature can be obtained. This is true of all algae except those whose life processes cause the deposition or secretion of calcareous material. Indefinite impressions of non-calcareous algae have been recorded from pre-Cambrian times through all

CRYPTOZOON
CAMBRIAN
TO SILURIAN
PRIMICORALLINA
ORDOVICIAN
DELESSERITES
ORDOVICIAN
THAMNOCLADUS
DEVONIAN
ALGAE

FIG. 2

geological ages, and somewhat more definite calcareous forms have a like range and are particularly abundant in some of the older rocks. They resemble the modern coralline or reef-building algae.

The second transparency shows four early types of algae. Cryptozoon, in the lower left corner, represents one of a variety of large concentric types, in some cases reaching several feet in diameter; they form reef-like masses in the pre-Cambrian and older Paleozoic rocks, and have now been found in North America, Europe, Asia, Greenland, and Australia. They are believed to be related to the blue-green algae, although some authors dispute even their organic nature. Supposedly related types are the genera *Weedia, Spongiostroma, Collenia,* and others.

The second restoration, *Primicorallina,* represents a clearly marked calcareous form with a hollow jointed axis carrying whorls of lateral branches at the nodes. Complete specimens are rare, but the detached joints make up masses in the Trenton limestone of New York, and there is not the slightest doubt of its algal nature, although its relationship to recent forms is not altogether certain. Most students compare it to the modern Dasycladaceae, of the Green algae (Chlorophyceae).

The third restoration, *Delesserites,* was named by Sternberg, one of the early cultivators of paleobotany, from its resemblance to the existing *Delesseria* of Lamouroux, one of the Florideae or Brown algae, and, like the modern genus, the Ordovician representative had a long ribbon-like thallus attached by a holdfast.

The fourth restoration, *Thamnocladus,* is a Devonian non-calcareous form of uncertain systematic position, which resembles the modern Rock weeds (Fucaceae or Dictyotaceae).

The associated animals shown in the transparency include jelly fishes; eurypterids and trilobites, which occupy the bionomic position of the crustacea of present day seas; primitive armored fishes; and ancient sharks.

The oldest fossil algae do not appear to be appreciably different from those of modern seas, and we infer that it is a safe generalization that those of the present are more diversified than those of the past, and portray for us all stages of algal morphology that may have existed in the vanished past.

3. Early Land Plants

In passing from the transparency devoted to Algae to that showing Early Land Plants, we are witnessing a most momentous evolutionary step, one that occurred in the early Paleozoic and which, eons later, made possible the evolution of warm blooded animals, and still later enabled the human species to become what we call civilized.

In the evolution of both plants and animals the transfer of the principal theater of their activities from the sea to the land was certainly from the point of view of humanity their greatest evolutionary change.

The exact steps in this change of habitat, either among animals or plants, we do not know, nor whether the terrestrial plants had a single (monophyletic) or diverse (polyphyletic) ancestry among the marine algae. It is clear, however, that algae were the ancestors of terrestrial plants, but beyond this cardinal fact all else is speculation. Certainly the most ancient known land plants, which might be considered to constitute a Pteridophytic (Fern type) or better perhaps an archegoniate[1] evolutionary stage, present unmistakable evidences of an aquatic ancestry. They have so many common features that community of origin seems almost certain.

We may pause for a moment to consider the problems which the emerging plants had to face in order to adapt themselves to a terrestrial existence. In their ocean home they lived in a medium that furnished mechanical support, one rich in food but somewhat deficient in light, roots except for anchorage were not required, no desiccation-resisting stage was necessary for dispersal. On the land the air gave no mechanical support nor salts for food. Although there was plenty of light, the plants were always faced with a deficiency of water, and they must also evolve some means for securing dispersal.

In addition to serving for anchorage, roots became absorbing organs to secure the necessary water and food salts; the surface, except for minute openings (*stomata*), became encased in cutin, impervious to gases, in order to conserve the water supply. In

[1] Mosses and Ferns and their relatives are, together, called Archegoniates because their egg-cells are produced in an organ called an archegonium.

PSILOPHYTON
DEVONIAN
RHYNIA
DEVONIAN
ASTEROXYLON
DEVONIAN
HYENIA
DEVONIAN
EARLY LAND PLANTS

FIG. 3

connection with an absorbing system (roots), conducting tissue for both water and elaborated products became a necessity; and lignin was brought into existence for mechanical support. Finally, in order to secure dispersal, a resting stage was intercalated in the alternating life-cycle. This stage was reduced to a single cell, the *spore,* which developed a cuticularized wall and was not only light but was capable of resisting heat, cold, and desiccation, and would hence retain its vitality until it reached a suitable environment for germination.

The earliest abundant representation of recognizable land plants that has been discovered occurs in rocks of Devonian age, although many students believe that the first invasion of the land must have been at a far earlier period. Among the rather numerous fragments that have been named, our interest centers on those plants which are more completely known. Among these, the first to be described and the one with the greatest range in time and space is *Psilophyton,* which was described by Dawson in 1859 and which is shown in the left hand corner of the transparency.

Dawson's account was long regarded with great scepticism, and it was not until similar petrified material was described in 1917 that the essential correctness of his work was recognized.

Psilophyton was a plant ten to twelve inches tall, which thickly carpeted the Devonian bogs, especially those of the lower and middle Devonian times. The erect shoots were borne on a creeping rhizome clothed with absorbing hairs. The slender stems were dichotomously branched and either smooth or covered with short spine-like outgrowths. Distally the tips of the branches were unfolded from crozier-like coils (circinate). Some of the ultimate branches bore enormous sac-like sporangia. The stem had a central solid *stele* (axial cylinder of vascular tissue), and there were no leaves. In life the stems were green and performed the photo-synthetic function. This we know because stomata have been determined on their surface. Our knowledge of all these features indicates painstaking investigation of the carbonized impressions by students of paleobotany.

The somewhat similar-looking *Rhynia,* shown next to *Psilophyton,* was undoubtedly related to it, and is much better known since it is preserved in a petrified condition in a silicified peat in

the middle Devonian of northern Scotland (Aberdeenshire). *Rhynia,* of which two species are known, was a small leafless and rootless plant, with a subterranean rhizome. The slender erect shoots were sparingly dichotomously branched (*i.e.,* forked), and sparingly covered with minute hemispheric projections. There was a small, solid, central stele, and the surface was green and photosynthetic. The ultimate branches bore large sac-like spore-cases (*sporangia*), with walls several cells thick. They were found to be full of spores, which were developed in groups of four (*tetrads*), as in all modern spore-producing plants.

An associated and related genus, *Hornea,* is even more simple than *Rhynia,* the particular point of interest being that the sporangia are obviously nothing but modified endings of the vegetative tissues, the spore-forming region corresponding anatomically to the inner cortex. Thus the spore-forming parts were but slightly differentiated from the vegetative, and were not morphological entities.

The third plant shown, *Asteroxylon,* was considerably more robust than the preceding, reaching a stem diameter of a centimeter and a height of a foot or more. The single Scotch species (middle Devonian) had a horizontal subterranean hairless rhizome, the ultimate branches of which burrowed in the peat like the roots of higher plants. The erect shoots had both forked and lateral branches, and were thickly covered with small simple leaves. These leaves had no vascular tissue, but the central star-shaped stele of the stem gave off vascular tissue for leaves (*leaftraces*), which ran through the outer tissue of the stem (*cortex*) but not into the leaves. The distal branches were smooth and bore large pear-shaped spore-cases, whose walls were thickened toward the summit where they split when the spores were ripe. A second species of *Asteroxylon,* from the middle Devonian of Germany, was similar to the Scotch species but sturdier. The leaves on the distal branches became reduced to spines, and the stele of the main stem was not solid but had a central pith.

These plants are grouped by the systematist in a separate order —the Psilophytales, and some students have thought that they were transitional between algae and true vascular plants, but this view cannot be maintained. Most botanists consider them to rep-

resent a primitive synthetic group from which both mosses (Bryophyta) and vascular plants were derived. Whether they are primitive and ancestral or merely ancient and simple they serve to give a very good idea of what we might expect to be the organization of the most primitive land plants.

The Psilophytales are the most ancient known representatives of a phylum to which the Lepidodendrons and Sigillarias of the coal swamps belong, and which survive in modern floras as herbaceous clubmosses and quillworts.

The fourth Devonian plant, shown in the right hand corner of the transparency, has been christened *Hyenia*, and is supposed to be a middle Devonian progenitor of the Horsetail group (shown in transparency No. 4). Two species are known, one from Norway and the other from Germany. The stems are less than an inch in diameter, not jointed, and fork dichotomously. The leaves are forked and are borne on the stem in whorls of three or four. The fructifications are loose terminal cones without bracts and with whorled forked *sporangiophores* (stalks bearing sporangia), each fork bearing two or three sac-like sporangia.

Before the close of the Devonian these ancient simple types were largely replaced by more complex types such as *Archaeopteris, Pseudobornia, Sphenophyllum, Cordaites* (*Callixylon*), *Protolepidodendron*, and *Bothrodendron* (*Cyclostigma*), which are illustrated and will be briefly described in the account of the next of this series of transparencies (No. 4).

4. Tree Clubmosses

This transparency, showing four different genera of the Tree Clubmosses, portrays a history extending from the upper Devonian to the close of the Paleozoic, and represented by a few hold-overs in the earlier Mesozoic. All are distantly related to the existing Clubmosses, and those who look at the past from the standpoint of the modern systematic botanist sometimes include these varied extinct forms in the modern Clubmoss order, Lycopodiales. It is, however, more logical to group all of these scale-leafed forms in a separate phylum—the Lepidophyta, and to recognize their undoubted distinctness from the Fern and the Horsetail groups.

The Tree Clubmosses were a great group characterized by small,

PROTOLEPIDODENDRON
DEVONIAN
BOTHRODENDRON
DEVONIAN
LEPIDODENDRON
CARBONIFEROUS – PERMIAN
SIGILLARIA
CARBONIFEROUS
– PERMIAN
TREE CLUBMOSSES

FIG. 4

simple, spirally arranged leaves. They usually produced two kinds of spores—small (microspores) and large (megaspores), in cones. This phenomenon is called *heterospory* (unlike spores). Although the majority had attained the stature of large trees in later Paleozoic times, their existing relatives are herbaceous perennials.

The fossil forms of which restorations are shown constitute at least three distinct families of the order Lepidodendrales, all of which are very prominent elements in Paleozoic floras. *Protolepidodendron,* or *Archaeosigillaria* as it is sometimes called, is a wide ranging type of the upper Devonian and earlier Carboniferous. Quite a few species have been described, the most complete of which was from the upper Devonian, near Naples, N. Y. A fine life sized restoration in the State Museum at Albany is the basis of the present picture. The dichotomously branched trunk, six or eight inches in diameter and about twenty feet tall, is covered with leaf scars, irregular near the butt, and like those of a ribbed *Sigillaria* above these. Higher up, the vertical ribs die out, and spirally arranged bolsters with rhomboidal leaf scars, resembling those of *Lepidodendron,* make their appearance. The persistent, lax, pointed leaves are a little over an inch long and much like those of *Bothrodendron.*

Protolepidodendron appears to have been a synthetic type, closely related to the common stock from which both the sigillarias and the lepidodendrons were derived.

The second type—*Bothrodendron*—really includes a number of related forms, the earlier often called *Cyclostigma.* They were larger than *Protolepidodendron,* with small remote leaf scars, usually without bolsters. The leaves were small, simple, and more or less persistent. The trunk had a thinner zone of secondary wood, and the cortex was less differentiated than in the lepidodendrons and sigillarias. Several sorts of cones have been considered to belong to *Bothrodendron*—some like the ordinary cones of the later lepidodendrons, and others lacking the radial elongation so characteristic of these.

The sigillarias and lepidodendrons of the later Paleozoic embrace a wide variety of forms, most of which were arborescent and some were over 125 feet tall with trunks over 6 feet in diameter. It would require too great space to even sketch the anatomi-

cal features, which are superficially very similar throughout, as are the leaves, the often large cones with two kinds of spores, and the structures which answer to roots and are known as *Stigmaria*. A *Stigmaria* is shown at the base of the *Sigillaria* windfall in the lower right hand corner of the transparency, and these stigmarias, with their rootlets, are among the commonest Carboniferous fossils, especially in the clays underlying the coal seams and in the roofing shales immediately above the coal.

In both *Sigillaria* and *Lepidodendron* the zone of secondary wood is thin and weak, and they sought to make up for this mechanical weakness by a greatly thickened and complicated cortex, which, since most of them grew in wet soil, necessitated rather elaborate devices for getting air inside. The geometrical patterns of leaf cushions with their leaf-scars, which ornament the surface of the trunks, are of great importance for classification, since so much of the fossil material consists of trunks or flattened fragments of cortex.

In *Lepidodendron* the leaves were borne on spirally arranged, crowded leaf-cushions or bolsters, which were always longer than wide, with sharp angles at the ends, and rounded sides. These bolsters show a subcircular leaf-scar with various subordinate scars of the central vascular strand, a pair of scars marking the strands of aerating tissue, and one above of the *ligule* (a membranous structure associated with the leaves).

In the sigillarias the scars are one above the other, the bolsters are usually not greatly elevated, and are wider than long, with the angles at the sides, and rounded above and below. A large group of sigillarias have the bolsters contiguous, forming prominent vertical ribs. The actual leaf-scars are not very different from those of *Lepidodendron,* but the leaves are frequently much longer. Both, after death, tend to have the cortex separate into layers, and with the decay of each layer the appearance of the stem changes. The older paleobotanists thought each represented a different genus for which they proposed names that are still useful as descriptive terms.

The sigillarias were much more sparingly branched, and seem to have varied more in habit than the lepidodendrons. Some pieces of stems of columnar species have been found preserved for a

length of seventy-one feet, being two feet in diameter at one end and tapering only four inches in that distance. Others were quite conical. One French specimen was six feet in diameter at the base, and tapered to a foot in diameter eighteen feet above the base. The curious and varied appearance of the sigillarias are well shown in the right hand third of the transparency.

5. Horsetail Group

Modern systematic botanists often classify the Horsetails or Scouring Rushes (*Equisetum*) as " fern allies," but they are really the survivors of a great independent group, which goes back to Devonian times and furnished some of the dominant arborescent forms during the later Paleozoic. To this group the name *Arthrophyta* is given.[1] They are characterized throughout their age-long history by having articulated and prevailingly ribbed stems with the relatively small leaves arranged in whorls (verticillate) at the nodes.

In the earliest forms (*Pseudobornia, Protocalamaria,* some species of *Sphenophyllum*) the leaves are somewhat less reduced and compound, but with the passage of time they become progressively smaller, and in the modern forms (*Equisetum*) the green stems and branches have taken over the photosynthetic function. Their spore producing organs are in the form of cones, although these show considerable morphological and histological variation. Some produce but one kind of spores (*homospory*), although the majority in the past produced both large and small spores (*heterospory*).

The Arthrophyta attained their maximum differentiation and size during the later Paleozoic, and since the Triassic they have been represented by only the single genus, *Equisetum.* They fall rather naturally into two main groups—the Sphenophyllae, represented by *Sphenophyllum* in the transparency, and the Calamariae, which includes *Pseudobornia* and *Calamites* of the transparency, as well as the more modern Equisetums.

The Sphenophyllums stand rather by themselves in the Horsetail group, since they show some features that remind one of the Lepidophytes. They range as impressions of slender jointed ribbed stems with whorls of mostly wedge-shaped small leaves

[1] Other names are Articulata, Calamophyta, and Sphenopsida.

PSEUDOBORNIA
DEVONIAN

SPHENOPHYLLUM
DEVONIAN TO TRIASSIC

CALAMITES
CARBONIFEROUS TO TRIASSIC

HORSETAIL GROUP

FIG. 5

from the latest Devonian to the Triassic (*Trizygia*), and are usually thought of as having had a clambering habit, like a modern bedstraw (*Galium*), which they somewhat resemble in size and appearance. This slender elongate habit led the earlier students to conclude that they were submerged aquatics, but the presence of mechanical tissue in the stems (solid steel of primary wood surrounded by a zone of secondary wood), and the abundance of stomata in the epidermis conclusively contradict such a mode of life. The cones were large and varied, one being exceedingly complex (*Cheirostrobus*), and in the main resembled those of *Calamites*. The restoration of both *Sphenophyllum* and *Pseudobornia* necessarily somewhat exaggerates the size of their leaves.

Pscudobornia, shown in the lower left hand corner, is somewhat imperfectly known, since no structural material and only impressions of the cones have yet been discovered. The bulk of the specimens come from the upper Devonian of the Arctic (Bear Island), and the genus has been only doubtfully recognized in North America and not at all in Europe. The main stems were up to four or five inches in diameter with non-alternating ribs. The leaves were in whorls, relatively large in size for this phylum, and palmately dichotomous. The cones were long lax affairs, and the sum of the features of *Pscudobornia* suggest that it was related to *Calamites*.

The true *Calamites*, of which several varieties are shown in the right half of the transparency, were one of the dominant plant groups of the late Paleozoic. In the first place many were of large size with a thick zone of secondary wood surrounding the pith. Pith casts twelve inches in diameter and thirty or more feet in length have been found fossil, and lead to estimates of heights of upwards of one hundred feet with trunk diameters of five or six feet. The branches were in whorls at the nodes, and the leaves were in whorls at the nodes of the branches, giving a beautiful symmetrically plumose plant, much like some of our larger existing bamboos in appearance. The foliage is of two principal types —needle-like (*Asterophyllites*) and flat uninerved leaves (*Annularia*). *Calamites* bore a considerable variety of cones, some of large size, and both cones, woods, and roots have been found petrified, so that we possess a great deal of detailed knowledge of the

group as a whole. Their structure clearly indicates that they were inhabitants of bogs and wet places.

6. Ferns and Seed Ferns

The ferns and seed-ferns are shown together, not because they are closely related but because they are similar in superficial appearance and have been confused until recent years. Everyone at all familiar with museum exhibitions, or with the roofing shales of coal mines, knows that the most abundant fossils are beautiful impressions of large fern-like fronds, and until recently the Carboniferous was looked upon as the age of ferns. The discovery that many of the more common fern-like plants (*Sphenopteris, Neuropteris, Alethopteris,* etc.), instead of being ferns, produced large complex seeds was one of the outstanding paleobotanical discoveries of the early years of the present century. Thus a large number of supposed Paleozoic ferns have been replaced by seed-ferns (Pteridosperms, or Pteridospermophyta).

Although the true ferns in the older rocks have become much shrunken in numbers they are by no means absent, but the similarity in foliage between ferns and seed-ferns is so great that, without the complete evidence of petrified material, it is scarcely possible to decide the true status of many genera. Thus *Archaeopteris,* shown in the lower left hand corner, is of uncertain affinity. It is based entirely upon the world wide occurrence of impressions of large fronds, and thus is in striking contrast with the small leaves of all the groups that have been mentioned thus far. It appears in the upper Devonian and continues into the lower Carboniferous, showing considerable variation in the details of its organization. Its leaves (*fronds*) were large, occasionally a meter in length, bipinnate, with stipules at the base of the leafstalk. Sterile pinnules were cuneate or obovate, with entire or variously toothed or laciniate margins and dichotomously flabellate veins. The fertile (spore-bearing) pinnules, borne on the same fronds with the sterile pinnules, had their blades greatly reduced and carried sessile or short-stalked, large, oval sporangia in groups of twos or threes. The sporangia are usually regarded as having no thickened ring (*annulus*), and consequently *Archaeopteris* was formerly considered to have been a true fern of the tropical fern Order,

ARCHAEOPTERIS
DEVONIAN
STAUROPTERIS
CARBONIFEROUS
PECOPTERIS
CARBONIFEROUS – PERMIAN
EOSPERMATOPTERIS
DEVONIAN
FERNS AND SEED FERNS

FIG. 6

Marattiales. Latterly, many students regard it as probably a seed-bearing fern (Pteridosperm).

Stauropteris is a true fern, as is shown by the cross-shaped form of the conducting tissue in the stem, and the ring-bearing (annulate) sporangia attached to the tips of the branches. It is found in the Carboniferous of Europe, and is not very completely known. The main axis of the frond is forked, and repeated branching gives it a bush-like appearance quite different from that of ordinary fern fronds.

A great many species of *Pecopteris*, based upon impressions of the fronds, have been described from the Carboniferous and Permian rocks, and are evidently not all related to one another. The typical *Pecopteris* fronds are large and usually tri- or quadripinnate, with the spores in groups (*synangia*) on the under side of the entire rounded pinnules. Some of these stems, when petrified, have been referred to a genus called *Psaronius* (starling stones), a name derived from the speckled appearance of their polished surfaces.

They are abundant in Saxony and polished specimens were especially prized as decorative objects in the eighteenth century. A great variety of species from the Carboniferous and Permian have been investigated, and sometimes these tree-fern trunks are also preserved as impressions (*Caulopteris, Megaphyton*). Some have the fronds arranged in crowded spirals and others in two or four vertical rows. The trunk is usually surrounded by a broad zone of closely packed adventitious roots. The fronds, spore containing organs (synangia), and stem anatomy are more like the existing ferns belonging to the small tropical fern family, Marattiaceae, than they are like any other modern ferns.

The single certain seed-fern shown, *Eospermatopteris*, is at the right in the transparency, and superficially is indistinguishable from the modern tree-ferns growing in the Garden greenhouses. It is also one of the oldest known seed-ferns. Other and later seed-ferns from the Carboniferous and Permian are much more completely known, but *Eospermatopteris* is of special interest since so many of their stumps have been found standing in the rocks along Schoharie Creek, near Gilboa, N. Y., just as they grew in upper Devonian time. They are found at several different levels, and

as many as eighteen have been quarried from an area of but fifty square feet. The largest is about three and one-half feet in diameter. Two species are represented in the transparency. They must have reached heights of at least thirty feet, their columnar trunks above the expanded butts being crowned with large tripinnate fronds at least six feet long, the pinnules being small and bilobed and of a type known as *Sphenopteridium*. Instead, however, of producing spores as do all ferns, these fern-like fronds bore toward their tips pollen- and seed-producing organs.

These are clearly shown in the pendant frond just to the left of the trunk, and in the one above in which the modified tip is outlined against the background of sky. The pollen was produced in distal clusters of funnel- or saucer-shaped affairs.

The nut-like seeds, about a quarter of an inch in diameter, were borne in pairs at the ends of forked branchlets. They were oval in form and were enclosed in an outer husk or cupule, which appears to have been lobed in some specimens.

The seeds of all of the recognized seed-ferns, some of which were very much larger than those of *Eospermatopteris,* have been rather fully investigated in some of the Carboniferous petrified forms, and show that they were much more complexly organized than are the seeds of our modern flowering plants, although they do show many features similar to those of the seeds of the Maidenhair Tree (*Ginkgo*) and the Cycads.

From our present knowledge it would seem that the seed-ferns far outnumbered the true ferns during the Paleozoic. Some undoubtedly continued into Mesozoic times, but the lack of structural material of these later suspects has thus far made it impossible to satisfactorily demonstrate their true nature.

7. Paleozoic Gymnosperms

The Gymnosperms comprise that ancient and extensive group of mostly arborescent plants which do not have their seeds enclosed. Their outstanding characteristic is the exposed ovules, discovered by Robert Brown in 1827, and exemplified in the cone of a pine or spruce, and the open-topped berry of a yew. Pollination, accomplished through the agency of wind in the Gymnosperms, brings the pollen in direct contact with the ovule. In the flowering plants

(Angiosperms) the ovules and resulting seeds are enclosed in an ovary or carpel, and the pollen falls on a receptive surface (*stigma*) where it sprouts and sends a tube through the tissues of the pistil and thus carries the sperm-cells to the enclosed egg-cell. The pollen may be wind-distributed, but more often the agency is flying insects or, less often, birds. Angiosperms are geologically much more recent than Gymnosperms, and are the dominant plants of existing floras.

Four types of gymnosperms are shown in the transparency devoted to Paleozoic Gymnosperms—*Poroxylon, Cordaites, Walchia,* and *Baiera.*

Poroxylon, at the left, represents a late Carboniferous and Permian type which is known chiefly by the anatomy of petrified stem fragments, and there is some uncertainty regarding its leaves, seeds, and catkins. The plants are thought to have been slender-stemmed, much like bamboos in appearance, with very large, flat, slightly fleshy, parallel veined leaves. They are considered to be related to *Cordaites,* the usual treatment being to consider the order Cordaitales as divided into three families—Poroxyleae, Cordaiteae, and Pityeae.

Cordaites was exceedingly abundant and varied at several horizons in the Paleozoic, and the synthesis of a study of impressions of their foliage and fructification, pith casts, and petrifactions enables us to draw a satisfactory picture of their general appearance and habit, although as yet it is usually impossible to correlate specific foliar impressions with petrified stems and seeds.

They were tall and relatively slender trees, with trunks that were frequently over one hundred feet in height and unbranched, except at the crown, where their spirally arranged foliage of simple and often large parallel veined leaves was displayed. Leaf-form has been used as a basis for the three form-genera: *Eucordaites,* with spatulate blunt-tipped leaves, often several inches in width and two or three feet in length; *Dorycordaites,* with pointed leaves approaching those of *Eucordaites* in size; and *Poacordaites,* with narrow linear leaves. The parallel venation, unbranched in *Poacordaites,* but repeatedly forked in *Dory-* and *Eucordaites,* suggest monocotyledon foliage, and the early writers consequently considered *Cordaites* as a monocotyledon. Both the wood structure,

POROXYLON
CARBONIFEROUS - PERMIAN
CORDAITES
DEVONIAN TO TRIASSIC
WALCHIA
CARBONIFEROUS - PERMIAN
BAIERA
PERMIAN TO JURASSIC
PALEOZOIC GYMNOSPERMS

FIG. 7

the floral organs, and the seeds were known long before their true nature was appreciated.

The stem has the general features of a modern conifer, except for the much larger pith, sometimes as much as 10 cm. in diameter, and often discoidal in consequence of the rapid elongation of the stem. Casts of this discoidal pith are frequently found as separate fossils and the early writers gave them the generic names *Artisia* or *Sternbergia*. Structurally the secondary wood is much like that of modern *Araucarias*, the chief feature being the dense crowding of the bordered pits of the tracheids into alternating series, often with hexagonal outlines. Many anatomical types of wood structure have been named (*Mesoxylon, Pitys, Callixylon, Mesopitys, Caenoxylon, Parapitys*, etc.).

The pollen was produced in sacs between spirally arranged bracts on a catkin-like axis. The seeds were borne in similar catkins and were usually bilaterally symmetrical and winged. A large variety of seeds as well as catkins (*Cordaianthus*) occur as impressions in all parts of the world, and petrified material has enabled students to obtain a rather full knowledge of their structure and habit.

The *Cordaites* group is usually assumed to have become extinct at the close of the Paleozoic, but a Triassic genus known as *Yuccites* appears to represent a Mesozoic survivor, and other later coniferous groups such as the araucarias, ginkgos, and yews show significant resemblances to the *Cordaites* stock.

Walchia, which appears in the geological record in the late Carboniferous and is specially characteristic of the Permian, is a conifer of very modern appearance, and may possibly be an early representative of the Araucarian line. This supposition has been followed in depicting these trees, which are made to look exceedingly like a Chilean or Norfolk Island Pine, and they were certainly like them in habit of branching and general appearance. *Walchia* had spirally arranged, crowded, falcate, decurrent, needle leaves, and the foliage shoots bore terminal cones of two kinds—pollen-bearing and seed-bearing with single-seeded scales. The material is mostly in the form of impressions, and the structural details are not clear.

At the right is a prostrate *Baiera* tree, and its characteristic

leaves are shown somewhat exaggerated as to size, so that their much divided fan-like form can be clearly seen.

Baiera, which is known almost entirely from impressions of the foliage, is generally considered an early member of the order (Ginkgoales) to which the *Ginkgo* belongs. It makes its appearance in the Permian, becomes especially abundant during the older Mesozoic, and some stragglers survive as late as the Cretaceous. During this long time *Baiera* attains a world wide distribution and has been found on all the continents. Since many of the features of this order can only be surmised from the features of the single existing species of *Ginkgo* (*Ginkgo biloba*), this should be kept in mind in all attempts to relate these plants to the Cordaites plexus on the one hand and to the modern conifers on the other.

8. Mesozoic Gymnosperms

The transparency devoted to Mesozoic Gymnosperms shows four highly characteristic Mesozoic types. The *Araucarioxylon* might well be an actual photograph taken of a modern Araucaria grove in southern Brazil or in the Chilean Andes. The modern species are about fifteen in number in two genera, and are confined to the Australasian and South American regions. They have many features of cone structure and trunk anatomy which serve to set them apart from all other existing conifers, and their true position among the Gymnosperms is a subject about which there is much difference of opinion.

Their remote ancestry is also one of dispute since the anatomy of the secondary wood is not appreciably different from that of *Cordaites,* and the term *Araucarioxylon* has been often used with such a dual meaning. As has been already mentioned, *Walchia,* which is shown among the Paleozoic Gymnosperms, has many features which suggest that it may have been an ancient member of the Araucarian line. The occurrence of large cones, single-seeded cone scales, and impressions of foliage in rocks of the early Mesozoic give indubitable evidence of the presence of Araucaria-like trees. These types become cosmopolitan during the Triassic and Cretaceous, and shrink to their present range at the antipodes during the Tertiary.

The other three Mesozoic Gymnosperms shown belong to a

ARAUCARIOXYLON
TRIASSIC
WIELANDIELLA
TRIASSIC
WILLIAMSONIA
JURASSIC-CRETACEOUS
CYCADEOIDEA
JURASSIC-CRETACEOUS
MESOZOIC GYMNOSPERMS

FIG. 8

group which is now usually considered to be a separate phylum under the name of Cycadophyta, and no group, existing or fossil, has excited a greater theoretic interest in recent years.

Pinnate fronds, like those of modern cycads, have been found as fossil impressions from the Carboniferous to the present, and the Mesozoic has often been spoken of as the Age of Cycads. The assumption that this wealth of Mesozoic forms represented plants just like the existing Cycads has become entirely discredited, and the three genera restored constitute a significant part of the evidence for this change of opinion.

The modern cycads, of which many specimens are to be seen in the Conservatories (House No. 12), constitute a compact group of about one hundred species of the tropical and subtropical regions of both hemispheres. Every genus is at present represented in the Botanic Garden collection. These plants have columnar or tuberous stems, armored with old leaf-bases and crowned with whorls of graceful pinnate leaves. The pollen and ovules are produced in separate and often large cones which are usually terminal at the center of the crown of leaves or sometimes in the axils of these leaves. Along with the *Ginkgo*, among modern seed plants, the sperm-cells are ciliated and swim from the pollen-chamber to the egg-cells, a habit which harks back to the aquatic ancestors of all land plants. Although the ancestors of the existing cycads are certainly pre-Tertiary in origin, they are now segregated in a separate order—the Cycadales, and the bulk of their Mesozoic relatives are referred to two distinct orders—the Williamsoniales, to which *Wielandiella* and *Williamsonia* belong, and the Cycadeoidales, to which *Cycadeoidea* belongs.

The Williamsoniales are a protean and long-lived group of forms, unfortunately known almost entirely from impressions. They appear in the late Paleozoic and continue sparingly into the early Tertiary. They have slender branched stems of considerable length and, instead of cones, a sort of a rude flower, consisting of a central conical mass of seeds and sterile scales, surrounded by a whorl of pollen-bearing appendages.

The upper Triassic genus, *Wielandiella,* had an elongated slender stem not over an inch in diameter, with repeated dichotomies, prevailingly naked except in the region of the forks, where it bore

spirally arranged, rather reduced fronds, either entire or pinnately divided. In each fork was a subsessile fructification surrounded by bracts. These fructifications are met with in two forms, probably representing different ages and states of preservation. In the one it consists of a small pyriform axis separated from the flower-stalk by a swollen striated collar bearing oval pollen-sacs on the surface of greatly reduced scale-like appendages. Ovulate structures on the pyriform axis appear to have been vestigial. In the second type the axis is hidden by the linear bracts, but its surface reveals a regular pattern of interseminal scales, between which the micropylar ends of the seeds are seen, indicating an organization of the ovule like that of the cycadeoids and *Williamsonia*.

Williamsonia was a larger and more varied type, especially abundant and world wide in its distribution in middle Mesozoic times. The stems are elongated and slender, but reach diameters of several inches and bear large pinnate fronds at the forks and terminally. The so-called flowers, to which the term *Williamsonia* was originally applied, and which are usually found detached, consist of a central ovulate receptable surrounded by a lobed disk bearing the pollen-sacs. These disks vary greatly in details, and various generic names are used to distinguish the different kinds.

The Cycadeoids, of which the one shown is typical, have for the most part simple squat tuberous trunks with a crown of one or several whorls of long graceful pinnate fronds, and are armored with the persistent leaf bases. Many are found in a beautifully petrified condition in the late Jurassic and lower Cretaceous, so that their structural features are exceedingly well known.

Instead of terminal cones there are short bract-covered axillary branches among the old leaf bases, which expand just at the surface of the armor clad trunk into hemispherical or conical receptacles. At the base of this receptacle is a sort of a collar which carries a whorl of bipinnate organs often called stamens, since they produce the pollen. After this is shed they wither, and consequently are not often petrified.

The receptacle carries quantities of stalked ovules, tightly packed between sterile scales so that only their tips, which give access to the sperms, are visible. These ovules develop into small seeds, each of which is almost completely filled by a large embryo having

two cotyledons. Each trunk will produce many such "flowers," apparently simultaneously, since some fossil trunks show none and others several scores. The "flowers" shown are depicted with the whorl of "stamens" expanded and unwithered.

These Mesozoic cycad-like plants disclose many features which suggest that their ancestry is to be sought among the seed-ferns of the Paleozoic, and the resemblance of their so-called flowers to the flowers of such flowering plants as *Magnolia* has led some students to see in these Mesozoic forms the solution of that botanical riddle—the origin of the flowering plants.

9. Angiosperms

The true flowering plants appear in rather familiar forms during the later Mesozoic. They show a great modernization at the close of the Cretaceous, and the Tertiary is quite as much the Age of Flowering Plants as it is the Age of Mammals. Much of the geological history of the more familiar Temperate Zone tree genera is known. These are so like their living descendants that there would be no point in preparing a transparency to illustrate them. Their chief interest is in the changes in distribution which they show, and the evidence which they furnish regarding changing environmental conditions, such, for example, as a wet delta forest in the Nubian desert in late Eocene times, or forests on the site of the Peruvian desert as late as Miocene time.

There are numerous trees found in Europe at the beginning of the Pleistocene, such as walnuts, hickories, magnolias, and gums, which were exterminated on that continent by the Pleistocene Ice Sheets. Similarly, in North America there are present in the late Tertiary many genera which today are natives of other continents, and many more, once found throughout our western states, but now confined to eastern Asia and southeastern North America.

NOTE ON THE PREPARATION OF THE TRANSPARENCIES

An exhibit of living plants, arranged to briefly illustrate the course of plant evolution from algae to flowering plants, was installed several years ago in Conservatory House No. 2. Brooklyn

Botanic Garden *Leaflets,* Series X, No. 6, June 14, 1922, *The Evolution Group at the Brooklyn Botanic Garden,* was published as a guide to this exhibit, and *Leaflets,* Series XVI, No. 1, *The Story of Plant Evolution,* appeared April 4, 1928.

More recently Miss Maud H. Purdy, Botanic Garden artist, has prepared a series of imaginary landscape views of geological ages, based upon illustrations of the fragments of fossil plant remains in standard publications. From these drawings the Botanic Garden photographer, Mr. Louis Buhle, has made the transparencies, which were put in place in June, 1932.

These transparencies supplement the evolution exhibit of living plants, and make the installation unique and one of unusual educational value for school classes as well as for the general public.

The evolution exhibit and the transparencies were planned by Dr. Alfred Gundersen, Curator of plants.

The Botanic Garden is pleased to acknowledge here its indebtedness and grateful appreciation to the following authorities who have been frequently consulted and have made constructive criticisms as the work has progressed: Prof. Edward W. Berry, Johns Hopkins University; Dr. Arthur Hollick, New York Botanical Garden; Dr. G. R. Wieland, Yale University and Carnegie Institution of Washington; and Prof. William K. Gregory, American Museum of Natural History (for animals).—C. S. G.

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GENERAL INFORMATION

Membership.—All persons who are interested in the objects and maintenance of the Brooklyn Botanic Garden are eligible to membership. Members enjoy special privileges. Annual Membership, $10 yearly; Sustaining Membership, $25 yearly; Life Membership, $500. Full information concerning membership may be had by addressing *The Director, Brooklyn Botanic Garden, 1000 Washington Avenue, Brooklyn, N. Y.* Telephone, Prospect 9-6173.

The Botanic Garden is open free to the public daily from 8 a.m. until dusk; on Sundays and Holidays it is open at 10 a.m.

Entrances.—On Flatbush Avenue, near Empire Boulevard and near Mt. Prospect Reservoir; on Washington Avenue, south of Eastern Parkway and near Empire Boulevard; on Eastern Parkway, west of the Museum Building.

The street entrance to the Laboratory Building is at 1000 Washington Avenue, opposite Crown Street.

To Assist Members and others in studying the collections the services of a docent may be obtained. This service is free of charge to *members of the Botanic Garden;* to others there is a charge of 50 cents per person. Arrangements must be made by application to the Curator of Public Instruction at least one day in advance. No parties of less than six adults will be conducted.

To Reach the Garden take Broadway (B.M.T.) Subway to Prospect Park Station; Interborough Subway to Eastern Parkway-Brooklyn Museum Station; Flatbush Avenue trolley to Empire Boulevard; Franklin Avenue, Lorimer Street, or Tompkins Avenue trolleys to Washington Avenue; St. John's Place trolley to Sterling Place and Washington Avenue; Union Street or Vanderbilt Avenue trolleys to Prospect Park Plaza and Union Street. By Automobile from points on Long Island take Eastern Parkway west and turn left at Washington Avenue; from Manhattan, take Manhattan Bridge, follow Flatbush Avenue Extension and Flatbush Avenue to Eastern Parkway, turn left following Parkway to Washington Avenue; then turn right.

BROOKLYN BOTANIC GARDEN
PUBLICATIONS

RECORD. Established, January, 1912. An administrative periodical issued quarterly (1912–1928); bimonthly beginning with 1929. Contains, among other things, the *Annual Report* of the director and heads of departments, special reports, announcements of courses of instruction, seed list, guides, miscellaneous papers, and notes concerning Garden progress and events. Free to members of the Garden. To others $1.50 a year. Circulates in 59 countries.

MEMOIRS. Established, July, 1918. Published irregularly. Circulates in 47 countries.

Volume I. *Dedication Papers:* comprising 33 scientific papers presented at the dedication of the laboratory building and plant houses, April 19–21, 1917. 521 pages. Price $3.50, plus postage.

Volume II. The vegetation of Long Island. Part I, The vegetation of Montauk: A study of grassland and forest. By Norman Taylor, June 11, 1923. 108 pages. Price $1.00, plus postage.

Volume III. Vegetation of Mount Desert Island, Maine, and its environment. By Barrington Moore and Norman Taylor, June 10, 1927. 151 pages. Price $1.60.

CONTRIBUTIONS. Established, April 1, 1911. Papers originally published in periodicals, reissued as "separates," without change of paging, and numbered consecutively. Twenty-five numbers constitute one volume. Price 25 cents each, $5.00 a volume. Circulates in 34 countries.

62. Physiologic races of Ustilago levis and U. avenae on red oats. 00 pages. 1932.

63. Inheritance of resistance to loose and covered smut in a hybrid of Early Gothland and Victor oats. 10 pages. 1932.

64. Inheritance of resistance to loose and covered smut in hybrids of Hull-less with Early Gothland and Monarch oats. 28 pages. 1932.

LEAFLETS. Established, April 10, 1913. Published weekly or biweekly during April, May, June, September, and October. The purpose of the *Leaflets* is primarily to give announcements concerning flowering and other plant activities to be seen in the Garden near the date of issue, and to give popular, elementary information about plant life for teachers and others. Free to members of the Garden. To others, fifty cents a series. Single numbers 5 cents each. Circulates in 28 countries.

GUIDES to the collections, buildings, and grounds. Price based upon cost of publication. Issued as numbers of the *Record;* see above.

Guide No. 6. Japanese potted trees (Hachinoki). 11 illustrations. Price, 35 cents. By mail, 40 cents.

Guide No. 7. The story of our boulders: Glacial geology of the Brooklyn Botanic Garden. 22 illustrations. Price, 35 cents. By mail, 40 cents.

Guide No. 8. The story of fossil plants. Guide to the transparencies in Conservatory House No. 2. 8 illustrations. Price, 35 cents. By mail, 40 cents.

SEED LIST. (*Delectus Seminum*) Established, December, 1914. Since 1925 issued each year in the January number of the RECORD. Circulation includes 160 botanic gardens and institutions located in 40 countries.

AMERICAN JOURNAL OF BOTANY. Established, January, 1914. Published, in coöperation with the BOTANICAL SOCIETY OF AMERICA, monthly, except during August and September. Subscription, $7.00 a year. Circulates in 53 countries.

ECOLOGY. Established, January, 1920. Published quarterly in coöperation with the ECOLOGICAL SOCIETY OF AMERICA. Subscription, $4.00 a year. Circulates in 48 countries.

GENETICS. Established, January, 1916. Bimonthly. Subscription, $6.00 a year. Circulates in 37 countries.

BROOKLYN BOTANIC GARDEN RECORD

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PROSPECTUS

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GENERAL INFORMATION CONCERNING THE ACTIVITIES OF THE BROOKLYN BOTANIC GARDEN

THE BROOKLYN BOTANIC GARDEN, established in 1910, is a department of the Brooklyn Institute of Arts and Sciences. It is supported in part by municipal appropriations, and in part by private funds, including income from endowment, membership dues, special contributions, and tuitions. Its articulation with the City is through the Department of Parks.

By an Agreement with the City of New York, the functions of the Garden have been defined as two-fold: first, the advancement of botanical science through original research; and second, the dissemination of a knowledge of plants.

The first of these activities is carried on by director, curators, resident investigators, fellows, and others, who devote all or a part of their time to independent investigation.

The second, the dissemination of botanical knowledge, is accomplished in the following ways:

I. By the teaching of classes—
   a. of children who come voluntarily outside of school hours;
   b. of children who come with their teachers from public and private schools for special lessons on plant life and closely related subjects;
   c. of adults who are interested in some phase of pure or applied botany, or of horticulture.

II. By lectures at schools and elsewhere by the various staff members.

III. By broadcasting.

IV. By loan sets of lantern slides accompanied by lecture text, for use in the schools.

V. By the distribution to schools of study material for classes in botany, biology, and nature study.

VI. By public lectures and educational motion pictures at the Botanic Garden.

VII. By maintaining labelled collections of living plants, arranged systematically, ecologically, and otherwise on the grounds and in the Conservatories of the Garden.

VIII. By the herbarium, containing specimens of preserved plants from all parts of the world.

IX. By maintaining a reference library on plant life and related subjects, open free to the public daily (except Sundays and holidays).

X. By the following periodicals and publications issued by the Botanic Garden:

1. American Journal of Botany (Monthly, except August and September).
2. Ecology (Quarterly).
3. Genetics (Bimonthly).
4. Brooklyn Botanic Garden Record, including Guides (Bimonthly).
5. Leaflets (Weekly or biweekly in Spring and Fall).
6. Contributions (Irregular).
7. Memoirs (Irregular).
8. Miscellaneous:

Syllabi of lectures.
Guide sheets for classes.
Announcement cards and circulars.
Bibliographies.
Miscellaneous books and booklets (*e.g.* "The Plant World," "Flower Games"), etc.

XI. By popular and technical articles in journals and the public press, including regular "News Releases" concerning Botanic Garden activities and events.

XII. By the maintenance of a Bureau of Public Information on all phases of plant life.

XIII. By providing docents to accompany members and others who wish to view the collections under guidance.

XIV. By cooperating with City Departments and other agencies in the dissemination of botanical knowledge.

The Brooklyn Botanic Garden is also taking an active part in the Nation-wide movement for Scenic Preservation and legislation for the conservation of our native American plants.

A brief summary and report of the public educational work of the Garden from 1910 to 1928, with some attempt to set forth the fundamental principles upon which it is based, was published in the Brooklyn Botanic Garden Record for July, 1929. On request, copies will be sent gratis to those engaged in educational work.

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BROOKLYN BOTANIC GARDEN RECORD

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PROSPECTUS: 1932–33

I. COOPERATION WITH LOCAL SCHOOLS

The Brooklyn Botanic Garden aims to cooperate in every practicable way with the public and private schools of Greater New York in all matters pertaining to the study of plants and closely related subjects. The purpose of the Garden in this connection is to supplement and enrich the school work in the way of instruction, demonstration, methods, study material, etc., which otherwise would not be available.

Geography classes, as well as classes in nature study and botany, find the collection of useful plants in the economic plant house, and also the Japanese Garden, the Meridian Panel, and the Labelled Boulders, valuable adjuncts to their class work. Arrangements may be made by teachers of geography to have their classes study these collections under guidance. Illustrated lectures for geography classes may also be arranged for at the Garden. See, also, pages 264 and 265 for statements concerning the Labelled Glacial Boulders and the Meridian Panel of special interest to classes in Geography and Geology.

The systematic collection in the main part of the Garden, where the living plants are arranged by orders and families, is proving of great value for demonstration to visiting high school and college classes in botany.

A. Talks at Schools.—The principals of public or private schools may arrange to have talks given at the schools on various topics related to nature study, such as garden work with children, tree planting, the conservation of wild flowers, and Arbor Day. If an illustrated lecture is desired, the lantern and

operator must be provided by the school, but slides will be furnished by the Botanic Garden. Address the *Curator of Elementary Instruction* for a list of talks and for appointments.

B. School Classes at the Garden.—(*a*) Public or private schools may arrange for classes, accompanied by their teachers, to come to the Botanic Garden for illustrated lectures either by the teacher or by a member of the Garden Staff.

(*b*) Notice of such a visit should be sent at least *one week* previous to the date on which a talk is desired. Blank forms are provided by the Garden for this purpose. These talks will be illustrated by lantern slides, and by the conservatory collection of useful plants from the tropics and subtropics. Fall and spring announcements of topics will be issued during 1932–33.

(*c*) The Garden equipment, including greenhouses, plant material, lecture rooms, lantern, and slides, is at the disposal of teachers who desire to instruct their own classes at the Garden. Arrangements must be made in advance so that such work will not conflict with other classes and lectures. For High School and College classes address the *Curator of Public Instruction*. For Junior High and Elementary School classes address the *Curator of Elementary Instruction*.

(*d*) The principal of any elementary or high school in Brooklyn may arrange also for a series of six lessons on plant culture to be given to a class during the fall or spring. A small fee is charged to cover the cost of the materials used. The plants raised become the property of the pupils. The lessons will be worked out for the most part in the greenhouse, and the class must be accompanied by its teacher. This is adapted for pupils above the third grade.

C. Lectures for High School, Junior High School, and Teachers' Training School Students.—To supplement biology studies in the schools of Brooklyn, a series of late afternoon lectures will be held in the spring of 1933, arranged especially for high school students. The subjects will be selected from among those in the New York Biology Syllabus, and will follow as closely as possible the sequence of that outline of study. Classes must be accompanied by their teachers. Announcements of topics will be issued early in 1933.

D. Seeds for School and Home Planting.—Penny packets of seeds are put up by the Botanic Garden for children's use. In

the early spring, lists of these seeds, order blanks for teachers and pupils, and other information may be secured on application to the *Curator of Elementary Instruction.*

E. Conferences.—Conferences may be arranged by teachers and principals for the discussion of problems in connection with gardening and nature study. Appointments must be made in advance. Address the *Curator of Elementary Instruction.*

F. Study and Loan Material.—To the extent of its facilities, the Garden will provide, on request, various algae and protozoa, as well as living plants, leaves and twigs, and other plant parts for study. When containers are necessary, as in the case of the algae and protozoa, they must be furnished by the school. In all cases arrangements must be made by the teachers for calling for such material. It will greatly aid in the speed and efficiency of service if teachers will write or telephone a day in advance of sending for material.

Messengers should call for the material at the Information Booth on the ground floor.

For the following material, address, by mail or telephone (Prospect 9–6173), Miss Hester M. Rusk.

1. Algae:
   Pleurococcus
   Spirogyra
   Vaucheria
   Desmids
   Blue-green algae: Oscillatoria and others.
2. Types of fungi and lichens.
3. Liverworts: Conocephalus and Lunularia.
4. Moss plants: protonema, " felt," and capsules.
5. Ferns:
   Prothallia: for these a covered Petri dish or tin box should be sent.
   Fronds with spores.
6. Elodea or Nitella—to show movement of protoplasm.
7. Specimens loaned for exhibit: e.g., leguminous roots with tubercles, plant diseases, modified leaves, demonstrations of Mendelism.
8. Protozoa: Paramoecium, Euglena, and others.

9. Sterilized nutrient agar for the study of bacteria and molds. This agar will be furnished in bottles; or, if teachers will send in their own Petri dishes, *clean and dry,* two weeks in advance, these will be filled ready for use.

For the following material, address, by mail or telephone (Prospect 9–6173), Miss Margaret M. Dorward.

10. Corn or sorghum stems, dried.
11. Twigs of maple, basswood, ailanthus, and others.
12. Simple and compound leaves.
13. Various seeds and fruits to illustrate methods of dispersal.
14. Geranium, Coleus, Tradescantia—variegated green and white, loaned for photosynthesis experiment.
15. Cacti, Pitcher plant (*Sarracenia*), Selaginella, sensitive plant (*Mimosa pudica*), Venus Flytrap (*Dionaea muscipula*), and others—loaned for demonstration.
16. Mounted specimens of leaves of trees mentioned in the Syllabus of Nature Study.
17. In spring, for school gardens, the surplus supply of seedlings from Botanic Garden classes.

G. Demonstration Experiments.—Teachers may arrange to have various physiological experiments or demonstrations conducted at the Garden for the benefit of their classes. Communications in regard to these matters should be addressed to the *Curator of Public Instruction.*

H. Loan Sets of Lantern Slides.—Sets of lantern slides have been prepared for loan to the schools. Each set is accompanied by a short lecture text of explanatory nature. In all cases these sets must be called for by a school messenger and returned promptly in good condition. Address, by mail or telephone, Mr. Frank Stoll. The subjects now available are as follows. Other sets are in preparation.

1. Plant Life
2. Spring Wild Flowers
3. Common Trees
4. Fall Wild Flowers
5. Forestry (2 sets)
6. Conservation of Native Plants

II. BUREAU OF PUBLIC INFORMATION

Each year hundreds of requests for information about plant life and gardening are answered by the various members of the Garden staff, in person, or by mail or telephone. These questions, many of them most unusual and interesting, extend into practically every field of pure and applied botany, and the information sought is gladly given wherever possible. Inquiries should be directed to the *Curator of Public Instruction,* preferably by letter.

Determination of Specimens.—If the identification of plants is desired, the material submitted should, if possible, include an entire leaf, and a flower cluster (inflorescence), or at least one flower. The fruit is also often desirable. If diseased plants are concerned, a representative specimen of the part diseased should be submitted.

III. DOCENTRY

To assist members and others in studying the collections the services of a docent may be obtained. Arrangements should be made by application to the *Curator of Public Instruction* one week in advance. No parties of less than six adults will be conducted. This service is free of charge to members; to others there is a charge of 50 cents per person. For information concerning membership in the Botanic Garden see page 3 of the cover of this PROSPECTUS.

IV. TEACHING STAFF

MONTAGUE FREE, Horticulturist.

Botanic Garden, Cambridge, England, 1899–1906; Warley Place Gardens, England, 1906–1908; First Class Certificate, Royal Horticultural Society, 1910; Royal Botanic Gardens, Kew (Certificate), 1908–1912; Dept. of Floriculture, N. Y. State College of Agriculture, Ithaca, N. Y., 1912–1913; Instructor in Floriculture, School of Horticulture for Women, Ambler, Penna., 1913; Head Gardener, Brooklyn Botanic Garden, 1914–1920; Horticulturist and Head Gardener, 1920–1924; Horticulturist, 1924–.

ARTHUR HARMOUNT GRAVES, Ph.D., Curator of Public Instruction.

A.B., Yale, 1900; Ph.D., 1907; University of London, 1914–1915; Assistant in Botany, Sheffield Scientific School and Yale School of Forestry, 1902–1904; Instructor in Forest Botany, Yale School of Forestry, 1904–1906; Instructor in Botany, Sheffield Scientific School, 1906–1909; Assistant Professor, 1909–1914; Associate Professor of Biology, Connecticut College for Women, 1916–1917; Pathologist and Collaborator, Office of Investigations in Forest Pathology, U. S. Department of Agriculture, 1918–; Curator of Public Instruction, Brooklyn Botanic Garden, 1921–.

ALFRED GUNDERSEN, Docteur de l'Université (Paris), Curator of Plants.

A.B., Stanford University, 1897; A.M., Harvard University, 1907; Docteur de l'Université, Paris, 1910; Teacher, secondary schools, Boston, Mass., 1898–1903; Assistant, Arnold Arboretum, 1910–1913; Herbarium Assistant, Brooklyn Botanic Garden, 1914–1915; Assistant Curator of the Herbarium, 1916–1919; Associate Curator of Plants, 1920–1924; Curator of Plants, 1924–.

GEORGE MATTHEW REED, Ph.D., Curator of Plant Pathology.

A.B., Geneva College, 1900; A.M., University of Wisconsin, 1904; Ph.D., 1907; Professor of Natural Science, Amity College, 1900–1903; Assistant in Botany, University of Wisconsin, 1904–1907; Instructor, 1907; Assistant Professor of Botany, University of Missouri, 1907–1912; Professor, 1912–1918; Pathologist, U. S. Department of Agriculture, 1919–1920; Curator of Plant Pathology, Brooklyn Botanic Garden, 1921–.

ELLEN EDDY SHAW, B.S., Curator of Elementary Instruction.

B.S., Tufts College, 1902; Tufts Medical School, 1902; Supervisor of Nature Study and Head of Science Dept., High School, Wayland and Cochituate, Mass., 1902–1905; Supervisor of Nature Study Dept., State Normal School, New Paltz, N. Y., 1905–1906, 1907–1909; Supervisor of Nature Study, Rochester City Training School, 1905–1907; Lecturer in Nature Study, State Board of Education, New York, 1907–1910; Teacher of Nature Study, Winthrop College Summer School, Rock Hill, S. C., 1910–1911–

1912; Supervisor of Nature Study, Ethical Culture School, New York City, 1910–1913; Lecturer in Spring Garden Course at Pratt Institute Kindergarten, 1912–1916; Lecturer in Nature Study, State Board of Education, West Virginia, 1912; Curator of Elementary Instruction, Brooklyn Botanic Garden, 1913–.

HENRY K. SVENSON, Ph.D., Assistant Curator of Plants.

A.B., Harvard University, 1920; A.M., 1922; Ph.D., 1928; Assistant, Arnold Arboretum, 1920; Instructor in Biology, Union College, 1922–1925; Assistant Professor, 1925–1927; Assistant in Gray Herbarium, Harvard University, 1928–1929; Editorial Work on Biological Abstracts, 1929; Assistant Curator of Plants, Brooklyn Botanic Garden, 1930–.

RALPH HOLT CHENEY, Sc.D., Resident Investigator (Economic Plants).

B.S., Boston University, 1918; A.M., 1919; M.S., Harvard, 1922; Sc.D., 1923; Assistant in Zoology, Radcliffe College, 1921; Assistant in Botany, Harvard, 1922; Instructor in Zoology, Western Reserve University, 1923; Assistant Professor of Biology, New York University, 1924–1929; Professor of Biology and Chairman of the Biology Dept., Long Island University, 1929–; Resident Investigator, Brooklyn Botanic Garden, 1931–.

MARGARET MAXWELL DORWARD, A.B., Acting Assistant Curator of Elementary Instruction.

A.B., Smith College, 1927; Assistant in Botany, Smith College, 1928; Instructor, Brooklyn Botanic Garden, 1930; Acting Assistant Curator of Elementary Instruction, Brooklyn Botanic Garden, 1930–.

H. DOROTHY JENKINS, A.B., Instructor.

A.B., Mt. Holyoke College, 1927; Assistant, Newark Museum, 1929–1930; Instructor, Brooklyn Botanic Garden, 1930–.

FRANCES M. MINER, A.B., Instructor.

A.B., Smith College, 1927; Local Director, Elmira Council Girl Scouts, Elmira, N. Y., 1927–1930; Director, Elmira Girl Scout Camp, 1928–1930; Instructor, Brooklyn Botanic Garden, 1930–.

HESTER M. RUSK, A.M., Instructor.

A.B., Columbia University, 1912; A.M., 1917; Instructor in Botany, Nebraska University Agricultural High School, 1913–1915; Assistant in Botany, Barnard College, 1915–1918; Instructor, 1918–1920; Technical Assistant, New York Botanical Garden, 1920–1926; Curatorial Assistant, Brooklyn Botanic Garden, 1926–1927; Instructor, 1928–.

V. COURSES OF INSTRUCTION

Courses of instruction are offered in Botany, Gardening, and Nature Study, and are divided into 4 classes:

A. For members and the general public ("A" courses, p. 247)
B. For teachers ("B" courses, p. 250)
C. For children ("C" courses, p. 253)
D. Other courses of a special nature ("D" courses, p. 255)

No course will be given when less than ten persons apply for registration. Since registration in many of the courses is restricted to a fixed number on account of the limited space available in the greenhouses, and for other reasons, those desiring to attend are urged to send in their application for enrollment and the entrance fee to the Secretary, Brooklyn Botanic Garden, several days in advance of the first exercise. This avoids delay at the beginning of the first exercise, ensures a place in the course, and enables the instructor to provide adequate material for the class.

The following equipment is available for the courses:

1. Three *Classrooms* (in addition to the Boys' and Girls' Club Room in the Laboratory Building), equipped with stereoscopes and views, a stereopticon, plant collections, economic exhibits, models, and other apparatus and materials for instruction.

2. Two *Laboratory Rooms,* with the usual equipment for plant study.

3. Three *Instructional Greenhouses,* for the use of juvenile as well as adult classes, for instruction in plant propagation and related subjects.

4. *The Children's Garden,* on a piece of land about three-quarters of an acre in extent, in the southeast part of the Botanic Garden, divided into about 150 plots which are used throughout the season for practical individual instruction in gardening.

5. *The Children's Building,* near the north end of this plot, containing rooms for conferences and for the storage of tools, seeds, notebooks, special collections, etc.

6. *The Auditorium,* on the ground floor, capable of seating 570 persons, and equipped with a motion-picture machine and stereopticon, and electric current, gas, and running water for experimental lectures.

In addition to these accommodations, the dried plant specimens in the herbarium, the living plants in the conservatories and plantations, and the various types of gardens are readily accessible, while the main library and children's library, which contain a comprehensive collection of books on every phase of gardening and plant life, may be consulted freely at any time. See also pages 259–265.

A. Courses for Members and the General Public

Although the following courses are designed especially for Members of the Botanic Garden, they are open to any one who has a general interest in plants. Teachers are welcome. Unless otherwise specified, these courses are *free to members;* * for others a fee is required, as indicated. In courses where plants are raised, these become the property of the class members.

A13. Flowering Plants of Greater New York: Fall Course.—Four sessions. Field identification of the flowering plants of Greater New York, with special reference to fall-flowering species and methods of seed dispersal. *Class limited to 30 members, taken in the order of application. Fee, $4.00. Saturdays,* 2:30 p.m., *September 24 to October 15.* Dr. Svenson and Miss Rusk.

A19. Ornamental Shrubs: Fall Course.—Six outdoor trips in the Botanic Garden and in Prospect Park for the purpose of becoming acquainted with the common species and varieties of cultivated shrubs. This is a continuation of the spring course. *Class limited to 20 members, taken in the order of application. Fee, $5.00. Tuesdays,* 4:10 p.m., *October 4 to November 15. (Omitting November 8.)* Dr. Gundersen.

* For information concerning membership in the Brooklyn Botanic Garden consult the third page of the cover of this PROSPECTUS.

A5. Trees and Shrubs of Greater New York: Fall Course.—Eight outdoor lessons in the parks and woodlands of Greater New York on the characteristics of our common trees and shrubs, both native and cultivated, emphasizing their distinguishing features in the winter condition. *Fee, $8. Saturdays,* 2:30 p.m., *October 8 to December 3. (Omitting November 26.)* The first lesson (October 8) will be given at the Brooklyn Botanic Garden.

Dr. Graves.

A20. Advanced Course in Gardening.—Ten lessons. This course presupposes a knowledge of the elements of gardening equivalent to that contained in courses A1 and A25. It consists of lectures illustrated with lantern slides and living material, and includes frequent tours in the Botanic Garden where the various types of gardens and other subjects of the lectures will be demonstrated. The subjects treated are as follows:

Oct.	26.	Water Gardens
Nov.	2.	Rock Gardens
"	9.	Roses
"	16.	Perennial Gardens
"	30.	Trees and Shrubs
Dec.	7.	Iris—Dr. Reed
"	14.	Insect Pests
"	21.	Plant Diseases—Dr. Reed
Jan.	4.	Plant Breeding—Dr. Reed
"	11.	Plant Propagation

Fee for members of the Garden $5; for non-members $15. Wednesdays, 11 a.m. *to* 12:30 p.m. *October 26 to January 11. (Omitting November 23 and December 28.)*

Mr. Free and Dr. Reed.

A1. Plants in the Home: How to Grow Them.—Five talks with demonstrations. Practice in potting, mixing soils, making cuttings, etc. This course deals with the principles to be followed in raising plants. The members of the class have the privilege of keeping the plants they have raised. *On account of restricted space in the greenhouse, this class must be limited to 40. Registration according to the order of application. Fee, $6 (including laboratory fee). Fridays,* 11 a.m., *October 28 to December 2. (Omitting November 25.)*

Mr. Free.

A23. Flower Arrangement.—Five sessions. This includes a discussion of color and color harmony, and the scientific principles on which they are based, and the choice of containers suitable for particular combinations. Three sessions on the principles of flower arrangement employed by the Japanese are included. Problems are worked out by the class. *Tuesdays,* 11 a.m., *January 3 to 31. Fee, $6.* Miss Mary Averill, Mrs. William H. Cary, Miss Maude Mason.

A24. The Child and His Garden.—A course planned along the lines of modern, progressive education. It is designed particularly for parents, with their children, but is open to any adult. A definite project is discussed each week, and the points involved are demonstrated by a model class of children. Any member of the class may request a place for a child in the demonstration group. These requests should come in early, as not more than eighteen children will be used each time. The age limits for the children are from eight to thirteen years, inclusive. Plants raised become the property of the child.

Jan. 7—How nature produces her children (Experiments).
Jan. 14—How boys and girls may help nature (Greenhouse).
Jan. 21—How to start plants from seed (Greenhouse).
Jan. 28—What a flower means. (Demonstration. Lessons in pressing and mounting flowers in preparation for summer vacation work.)
Feb. 4—How to start a little garden. (Choice of desert garden, woods garden, or rock garden.)

This course has been arranged as an educational experiment, and is not open to the general public. Miss Shaw.

A25. The Fundamentals of Gardening.—A course in first principles, designed for those who have had little previous experience but who desire to carry on practical work in their own gardens. The lessons are as follows:

Jan. 25. Preparation and improvement of the soil. Mr. Free.
Feb. 1. Pruning trees and shrubs. Mr. Free.
Feb. 8. Transplanting trees and shrubs. Mr. Free.
Feb. 15. Seed sowing in the greenhouse. Miss Shaw.
March 1. Pricking out seedlings in the greenhouse. Miss Shaw.

March 8. Combining perennials and annuals in the small garden. Mr. Free.

Fee, $7 (including laboratory fee). Wednesdays, 11 a.m., *January 25 to March 8. (Omitting February 22.)*

Mr. Free and Miss Shaw.

A9. Trees and Shrubs of Greater New York: Spring Course.—Ten outdoor lessons in the parks and woodlands of Greater New York, the principal object being to gain a ready acquaintance with the common trees and shrubs of the eastern United States, which are well represented in this region. The species are considered in systematic order, and the features pointed out by which they may most easily be recognized; also their habits, rate of growth, economic value and use, methods of planting and propagation; importance in forestry, horticulture, and landscape art. *Fee, $10. Saturdays,* 2:30 p.m., *April 1 to June 3.* Dr. Graves.

A8. Plant Families.—Eight outdoor lessons in the Botanic Garden, taking up the structure and possible lines of evolution of flowers and the characteristics of the more important plant families, such as the Magnolia, Buttercup, Mustard, Pink, Rose, Plum, Apple, Geranium, Mallow, Carrot, Dogwood, Heath, Potato, Figwort, Mint, and Composite Families. *Fee, $8. Two divisions, Tuesdays: Division I,* 11 a.m.; *Division II,* 4:10 p.m., *April 11 to June 6. (Omitting May 30.)* Dr. Gundersen.

A11. Flowering Plants of Greater New York: Spring Course.—A field course of eight sessions in the parks and woodlands of Greater New York. The common native and naturalized wild flowers are studied as they come into flower, and their distinguishing features pointed out. *Class limited to 30 members, taken in the order of application. Fee, $8. Saturdays,* 2:30 p.m., *April 22 to June 10.* Dr. Svenson and Miss Rusk.

B. Courses for Teachers: Given in Cooperation with the Brooklyn Teachers Association

These courses have been accepted by the Brooklyn Teachers Association, and appear in its Syllabus of Courses. On satisfactory completion of each course, the student is awarded a certificate by the Brooklyn Teachers Association, in cooperation with the Brooklyn Botanic Garden. The courses are also accepted by the New

York Board of Education for credit toward higher teaching licenses, one credit being granted for each 15 hours (with the exception of "B8, Plant Culture"). Credits may also be used toward advanced standing in colleges or universities. Through an agreement made in January, 1931, with Long Island University, undergraduate credit for these courses will be allowed toward fulfilling the requirements for a university degree, provided the admission requirements at the University and the laboratory requirements have been fulfilled. Nature materials used in the courses, and plants raised become the property of the student.

Members of the Garden are entitled to a 50 per cent. discount from the regular fee for all "B" courses; from other persons the indicated fee is required. *No course will be given when less than ten persons apply.*

B1. General Botany.—A two-year course, of thirty sessions each year, on the structure and functions of plants. The first year (**A**) is spent on seed plants. The second year (**B**) the lower groups are dealt with—bacteria, algae, fungi, lichens, mosses, ferns, their life histories and relationships. Optional laboratory work each week with the compound microscope. For the year 1932–33 the first half of the course (**A**) will be taken up. The first half is not a prerequisite for the second. Students may elect either or both parts of the course, which are given in alternate years. *Fee, $10 each year. Laboratory fee, $5. Thursdays,* 4 p.m., beginning *September 29.* Miss Rusk.

B10. Trees and Shrubs of Greater New York.—Eighteen sessions. A course of outdoor lessons in the parks and woodlands of Greater New York, the principal object being to gain a ready acquaintance with the common trees and shrubs of the eastern United States, which are well represented in this region. The species are considered in systematic order, in both winter and summer conditions, and the features pointed out by which they may most easily be recognized. Two credits are given for this course. *Fee, $15. Saturdays,* 2:30 p.m., *October 8 to December 3 (omitting November 26); and April 1 to June 3 inclusive.*

Dr. Graves and Miss Vilkomerson.

B2. Nature Study.—Thirty sessions. This course is based on the New York City outline of nature study for grades three to

six inclusive. Mounts, charts, and diagrams are made. The student becomes familiar with actual material. The course is entirely practical, work being done in both field and laboratory. *Fee, $15. Tuesdays,* 4 p.m., beginning *September 27.*

Miss Shaw and Miss Miner.

B3. Principles of Agriculture and Horticulture.—Thirty sessions. This course is especially helpful to teachers. The principles of horticulture are considered and applied in a practical way through greenhouse, laboratory, and lecture work. The greenhouse work includes the following subjects: plant propagation by means of bulbs, rhizomes, roots, seeds, etc.; the care of the greenhouse; house plants; window-box materials; fertilizers. Insect and fungous pests, grafting, and pruning are also included from both a practical and a theoretical point of view. *Class limited to 60 members. Fee, $15. Wednesdays,* 4 p.m., beginning *September 28.* Miss Shaw and Miss Dorward.

B7. Greenhouse Work.—Thirty sessions. A course for those interested in indoor and outdoor gardening. Lessons in repotting ferns; forcing blooming plants; methods of propagation; insect pests and plant diseases; making dish gardens; preparing for the outdoor garden. Most of this work is carried on in the greenhouses. Emphasis will be laid on problems of a practical nature. Limited to those who have taken B3 and planned to follow this course. *Fee, $15. Tuesdays,* 4 p.m., beginning *September 27.*

Mr. Free and Miss Dorward.

B8. Plant Culture.—A course of fifteen weeks duration for those who have taken B3 and B7. Work entirely in the greenhouse. *No Board of Education credits are given for this course. Fee, $15. Thursdays,* 4 p.m., beginning *October 20.* Miss Shaw.

B4. Educational Principles of Children's Gardening and Nature Study.—Fifteen sessions. In this course special stress will be laid on nature study and gardening problems in the schools of the City. This forms a thirty week course with B5. *Fee, $7.50. Mondays,* 4 p.m., beginning *September 26.* Miss Shaw.

B5. Children's Garden Practice.—Fifteen sessions. This course is entirely practical and includes all the outdoor work of the student in his own garden, applying the principles of agriculture and gardening, and work with children in the garden. This forms

a thirty week course with B4. *Fee, $7.50. Mondays,* 4 p.m., beginning *February 6.* Miss Shaw and Miss Jenkins.

B9. Economic Plants.—Thirty sessions. The most important economic plants of the world are considered—their history, culture, formation of their useful products, and the extraction and preparation of the latter by man. Herbarium specimens and other material, as well as living plants in the conservatories and plantations of the Garden will be used for demonstrations. Because of its practical applications, this course will be of especial value to teachers. *Fee, $15. (Not offered in 1932–33.)*

Dr. Cheney.

C. Children's Courses

The following courses are open to all boys and girls. Enrollment in these courses entitles the boy or girl to membership in the Boys' and Girls' Club of the Brooklyn Botanic Garden. Papers, by members of the Club, on various botanical and horticultural subjects, are read at the meetings, and the speakers are then entitled to a silver pin, providing they have satisfactorily completed work for their bronze medal and have received it. For information concerning Children's Room, the Children's Building, and the Children's Garden, see page 262.

C1. Fall Greenhouse Work.—The following courses are given for boys and girls interested in greenhouse work and botanical nature study. *The fee is ten cents.*

Miss Dorward, Miss Jenkins, and Miss Miner.

Class A.—Open to boys and girls from eight to twelve years old. *Saturday* mornings at 9:15. *October 22 to December 17.*

Class B.—Open to boys and girls twelve years of age and over. *Saturday* mornings at 10:00. *October 22 to December 17.*

C2. Special Activities.—Special work as applied to greenhouse and garden activities. Members for this class will be selected from honor students in the fall courses. Work is open only to boys and girls fourteen years old and over. *No fee.* Given in January and February, 1933. Miss Shaw and Miss Dorward.

C3. Preparation for the Outdoor Garden.—The following classes are open to boys and girls during the spring of each year. The courses are planned for a better understanding of plant life

and so that the outdoor garden may become a more intelligent piece of work. *On account of limited space in the Children's Greenhouse, classes are limited to twenty. The fee for each is fifteen cents to cover the cost of material.*

Miss Dorward, Miss Jenkins, and Miss Miner.

Class A.—Open to boys and girls from eight to twelve years old. *Saturday* mornings at 9:15. *February 25 to April 29.*

Class B.—Open to boys and girls twelve years of age and over. *Saturday* mornings at 10:00. *February 25 to April 29.*

C4. Advanced Work for Older Boys and Girls.—How to raise plants, mix soils, transplant, start seedlings for outdoor gardens, etc. Boys and girls who have taken spring courses under C5 are eligible for advanced work. *The fee for the course is twenty-five cents.* Each student may take home his plants and seedlings. This course is open to both boys and girls over twelve years of age. *Saturday* mornings at 9:30, *February, 1933.*

Miss Dorward.

C5. The Beginners' Outdoor Garden.—Open annually to 90 boys and girls who carry on their projects in gardening on plots 8 ft. by 10 ft. No person is eligible for a garden who has not been a member of spring classes. *Fee, twenty-five cents. Saturday* mornings, 9–12, *May 13 to October 7.*

Miss Shaw and Assistants.

C6. The Advanced Outdoor Garden.—Open to 75 boys and girls who have had several seasons in the Beginners' Garden (C5). All candidates must have been in spring classes. *Fee, fifty cents. Saturday* mornings, 9–12, *May 13 to October 7.*

Miss Jenkins and Assistants.

C7. Junior Garden Assistants.—Open to older boys and girls or to those who have mastered Courses C2 and C4. Size of plot 10 ft. by 15 ft. Registration date: *May 7. No fee.*

Miss Jenkins.

C9. Nature Study for Boy Scouts, Girl Scouts, Camp Fire Girls, Scout Leaders, and Others.—Short courses of at least four periods each, with talks, demonstrations, and field trips in the grounds of the Botanic Garden and Prospect Park to study trees, shrubs, etc. The instruction and schedule dates will be adapted to meet the needs of the various groups that apply. *Open only to groups of at least ten persons.* Hours to be arranged. *No fee.*

Dr. Graves, Miss Miner, and Assistants.

C10. Special Work for High School Pupils.—A course in gardening or greenhouse work adapted for high school pupils. Classes to be arranged for by the high school teacher. *Fee for materials used.* Miss Shaw and Assistants.

D. Course for Student Nurses

D1. General Botany With Special Reference to Medicinal Plants.—A course of 10 spring and 10 fall conferences, demonstrations, and field trips for student nurses. The general principles governing the life of plants, as well as the use and care of flowers and potted plants in the sick room will be considered. Special attention will be paid to the identification of officinal plants in the field. Hours to be arranged. *No fee.* Dr. Graves.

E. Consultation and Independent Investigation

1. *Consultation*

Consultation and advice, and the facilities of the laboratories, library, and herbarium are freely at the service of members of the Botanic Garden and (to a limited extent) of others with special problems relating to plants or plant products, especially in the following subjects:

1. **Plant diseases** (phytopathology) and classification of fungi (mycology). Dr. Reed.
2. **Plant geography** (phytogeography) **and ecology.** Dr. Svenson.
3. **Classification and identification of flowering plants** (systematic botany). Special groups studied in the Garden, supplemented by herbarium studies. Dr. Gundersen.
4. **The growing of cultivated plants** and their arrangement; also their adaptation to soils, climate, and other factors (horticulture and gardening). Mr. Free.

2. *Investigation* *

For the following research courses, open to those properly qualified for independent investigation, there is a charge covering all

* Courses of graduate rank offered by the Botanic Garden, when approved by the Faculty of the Graduate School of New York University, are listed

expenses, including laboratory fee, of *$30 for each full course* of 100 credit hours, and *$20 for each half course* of 50 credit hours.

E6. Research in Mycology and Plant Pathology.—Independent investigation of problems relating to fungi and fungous diseases of plants. Dr. Reed.

E8. Research in Forest Pathology.—Independent investigation of the diseases of woody plants. Dr. Graves.

E9. Research in Systematic Botany of the Flowering Plants. Dr. Gundersen and Dr. Svenson.

VI

MISCELLANEOUS

Press Releases

In order to keep the public informed of events at the Garden, news items are sent at fairly regular and frequent intervals to the metropolitan dailies and to many of the suburban papers. They are also mailed, as issued, to members of the Board of Trustees and the Woman's Auxiliary. These news releases consist of announcements of the periods when the principal floral displays are at their best, of the acquisition of new plants, the blossoming of rare species, improvements in the plantations, the installation of new collections and exhibits, the results of research and exploration, etc. The commencement of the various public courses, as well as public lectures and meetings of various societies at the Garden, are also announced through the public press.

Circulars of Information

Circulars descriptive of the various courses and lectures are distributed, without charge, according to a regular mailing list which includes all the libraries and schools of Greater New York, Botanic Garden members, and others. Requests to be placed on this mailing list should be addressed to the *Curator of Public Instruction.*

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as courses in the Graduate School, and are given the same credit as other graduate courses. Properly qualified students who take these courses may present them in satisfaction of the requirements for advanced degrees given by the University. Graduate credit has also been allowed elsewhere for such advanced work done at the Garden.

Popular Publications

Leaflets.—The publication of the Brooklyn Botanic Garden *Leaflets* commenced in 1913. Approximately ten numbers—sometimes more—constitute a Series, one series being issued each year. The current series is Number XX. At the end of every four years, for convenience in binding, a table of contents of the *Leaflets* published during the four year period is issued.

The purpose of the *Leaflets* is primarily to give announcements concerning flowering and other plant activities to be seen in the Garden near the date of issue, and to present popular information about plant life in general for teachers and others. The *Leaflets* are free to members of the Garden and (on request) to teachers in the schools of Greater New York. For others, the subscription is 50 cents per year, or 5 cents a number (4 pages); double or triple numbers (8 or 12 pages) at the same rate.

Besides the *Leaflets,* numerous popular articles on various phases of plant life and gardening are written by members of the staff for publication in periodicals and newspapers.

The Plant World.—By C. Stuart Gager. A popular introduction to the more interesting facts concerning the plant life of the earth, and the importance of plants in our daily lives. 136 pages; 79 illustrations. Price 75 cents. On sale at the Information Desk and Entrance Gates, and by mail.

Guide Books, Maps, and Souvenir Postcards of the Garden

During the last few years, Guide Books have been published from time to time, as special numbers of the *Brooklyn Botanic Garden Record,* based upon and explaining various Botanic Garden features and exhibits.

Each of these publications is more than a guide to an exhibit; it is an elementary treatise on the general subject illustrated by the Garden feature or exhibit. In this way the Guides have value even for those who may not be able to visit the Botanic Garden. The following numbers have been published:

Guide No. 2. Gardens within a garden: A general guide to the grounds of the Brooklyn Botanic Garden. By C. Stuart Gager. May, 1929. 36 pages, 16 illustrations and map. Price, 25 cents. Out of print.

Guide No. 3. The story of our metate: A chronicle of corn. By F. W. Hodge. November, 1929. 25 pages, 14 illustrations. Price, 25 cents.

Guide No. 4. The Japanese Garden of the Brooklyn Botanic Garden. By Bunkio Matsuki. July, 1930. 38 pages, 20 illustrations. Price, 35 cents; by mail, 40 cents.

Guide No. 5. The Rock Garden of the Brooklyn Botanic Garden. By Montague Free. May, 1931. 55 pages, 28 illustrations. Price, 35 cents; by mail, 40 cents.

Guide No. 6. Japanese potted trees (Hachinoki). By Bunkio Matsuki. November, 1931. 16 pages, 11 illustrations. Price, 35 cents; by mail, 40 cents.

Guide No. 7. The story of our boulders: Glacial geology of the Brooklyn Botanic Garden. By C. Stuart Gager and Ernst Antevs. May, 1932. 43 pages, 22 illustrations. Price, 35 cents; by mail, 40 cents.

Guide No. 8. The story of fossil plants. Guide to the eight transparencies in Conservatory House No. 2. By Edward W. Berry. July, 1932. 29 pages, 8 illustrations. Price, 35 cents; by mail, 40 cents.

These Guides are mailed free, as published, to members of the Garden. Similar guides are in preparation and will be published from time to time.

A detailed map of the Garden, showing not only the various types of gardens included in the Botanic Garden area, but especially the location of the various orders and families in the Systematic Section, is appended to the General Guide. Copies are on sale at 5 cents each.

A colored picture map of the Garden, $7\frac{1}{2} \times 3\frac{1}{2}$ feet, designed and executed by Miss Helen Sewall, is on view in the Laboratory Building. This map was presented to the Garden at the Annual Spring Inspection, May 14, 1929, as a memorial to the late Dr. Glentworth R. Butler by members of the Woman's Auxiliary and other friends of Dr. Butler. Photographs of this map (in black and white, $6\frac{1}{2} \times 4\frac{1}{4}$ inches) may be had at 20 cents each.

Souvenir postcards, in colors, may be had at 15 cents a set (6 cards); two for 5 cents; 3 cents each. The subjects are: Scene in the Children's Garden; The Brook; Daffodils in the Lawn;

The Lake; Children's Building and Formal Garden; The Rock Garden (Waterfall and Iris); The Japanese Garden (Wisteria); Inflorescence of Sago Palm.

Orders for guide books, maps, and souvenir postcards, accompanied by remittance, should be sent to *The Secretary*. These articles may also be obtained at the Information Desk in the Laboratory Building, and at the Entrance Gates.

VII

OTHER EDUCATIONAL FEATURES

Plantations

The plantations comprise the following sections:

1. General Systematic Section (trees, shrubs, and herbaceous plants arranged according to orders and families).
2. Local Flora (native wild flower garden). Arrangement ecological.
3. Ecologic Garden.
4. Rock Garden.
5. Japanese Garden.
6. Rose Garden.
7. Iris Garden.
8. Water Gardens (Lake, Brook, Swamp, Bog, Pools).
9. Children's Garden.
10. Shakespeare Garden.
11. Horticultural Garden.
12. Conservatory Plaza (Pæonies, Water Lilies, Hollyhocks).
13. Laboratory Plaza (Magnolias).
14. Experimental Garden.
15. Nursery.

As noted under *Docentry,* arrangements may be made for viewing the plantations under guidance. They are open free to the public daily from 8 a.m. until dusk; on Sundays and holidays from 10 a.m. until dusk.

Flower Days

In order to afford members of the Garden and friends whom they may invite, an opportunity to see, under expert guidance,

some of the most conspicuous and interesting floral displays of the Garden; to assist them toward solving some of their own gardening problems; and to enable them to meet for discussion, a series of special days, called Flower Days, was inaugurated in 1927. The dates selected are those in which the particular flowers furnishing the theme for discussion are in their prime. Up to and including 1932 the following "Days" have been observed:

Crocus Day
Daffodil Day
Tulip Day
Rock Garden Day
Japanese Garden Day
Iris Day
Rose Garden Day (June)
Water Garden Day
Fall Rose Garden Day
Canna Day
Chrysanthemum Day

On each of these occasions a specialist gives an illustrated talk on the flower of the Day, followed by a tour of inspection of the flowers in bloom on the grounds of the Garden. The speakers are either members of the Garden staff who have made a special study of the flowers in question, or invited experts in their breeding or growing. During the outdoor inspection, members may discuss with the leader questions of desirable varieties, culture, disease, etc. On the return to the Laboratory Building, tea is served. The exercises commence at 3:30 p.m. These Flower Days have increased in popularity each year. The total attendance on the six Days last year was nearly 900.

Conservatories

The Garden conservatories contain a collection of tender and tropical plants. Of special interest for teachers of nature study and geography are the following useful plants from the tropics and subtropics: banana, orange, lemon, lime, kumquat, tamarind, West Indian cedar (the source of the wood used for cigar boxes), eucalyptus, Manila hemp, sisal, pandanus (source of the fiber used for making certain kinds of fiber hats), fig, grapevines from north and south Africa, date palm, coconut palm, chocolate tree, coffee, tea, ginger, bamboo, mahogany, balsa, cocaine plant, black pepper, annatto (used in coloring butter and cheese), cardamom,

olive, pomegranate, logwood, durian, mango, sugar cane, avocado (so-called "alligator pear"), West Indian and other rubber plants, banyan, religious fig of India, and numerous others.

It may be of interest to teachers that the nine extant genera of cycads are now represented in House 12. To reach the Cycad House take the first door to the *left* after entering the central or Economic House and pass through to the end house.

The Conservatories are open April 1 to October 31, 10 a.m.–4:30 p.m. (Sundays, 2–4:30); November 1 to March 31, 10 a.m.–4 p.m. (Sundays 2–4).

Herbarium

The Garden herbarium consists at present of about 200,000 specimens, including phanerogams, ferns, mosses, liverworts, lichens, parasitic and other fungi, algae, and myxomycetes. This collection may be consulted from 9 a.m. until 5 p.m. by those interested, and specimens submitted will be gladly identified.

Library

The rapidly growing library of the Garden comprises at present more than 17,000 volumes and more than 13,000 pamphlets. This is not a circulating library, but is open free for consultation to all persons daily (except Sundays and holidays) from 9 a.m. until 5 p.m. (Saturdays, 9 to 12). More than 900 periodicals and serial publications devoted to botany and closely related subjects are regularly received. These include the transactions of scientific societies from all quarters of the globe; the bulletins, monographs, reports, and other publications of various departments of the United States Government, as well as those of foreign governments, and of all state agricultural experiment stations and agricultural colleges; the publications of research laboratories, universities, botanic gardens, and other scientific institutions of the world, as well as the files of independent journals devoted to the various phases of plant life. The library is specially rich in publications of foreign countries and has a growing collection of incunabula and other pre-Linnean works.

Bibliographical assistance is rendered to readers by members of the Library staff.

Laboratory Building

The Laboratory Building contains (besides offices of administration and the Library and Herbarium mentioned above) four laboratory rooms, a culture room, three classrooms with stereopticon and other equipment for instruction, a room for the installation of temporary exhibits, six private research rooms, and an auditorium seating about 570 and equipped with motion picture machine, stereopticon, and lecture table supplied with water, gas, and electric current for lectures involving experimental work.

Instructional Greenhouses

A range of three greenhouses, each about 20 x 30 feet, is provided for the practical instruction of children and adults in plant propagation and other subjects.

Children's Room

A gift of $1,500 in 1921 from Mrs. Helen Sherman Pratt, supplemented in 1923 by a further gift of $500 from Mr. George D. Pratt, has made it possible to provide a beautifully decorated room for the use of the Boys' and Girls' Club. Any boy or girl who is enrolled, or has been enrolled, in any of the children's classes at the Garden is eligible for membership in this club, which now numbers about 1,000 active members. The room contains shelves for a nature-study library, of which a nucleus has already been secured, and is equipped with stereoscopic views, photographs, and preserved and living specimens of plant life, for the instruction and entertainment of boys and girls. The room is open free to all children. Contributions of specimens and of books on nature study and closely related subjects will be most welcome.

Children's Building

This is located in the northern part of the Children's Garden plot and contains a conference room, and rooms for the storage of garden tools and implements. The furniture in the conference room was a gift from Mrs. James H. Post. Various collections of plants, seeds, and insects of economic importance in the garden

are accessible here for consultation by the children. A garden library, a gift of friends, has been added. North of the Children's Building is a plot planted to ornamental shrubs and herbaceous perennials for the instruction of the children.

Children's Garden

A plot of about three-quarters of an acre in the southeast part of the Botanic Garden is devoted to the theoretical and practical instruction of children in gardening. The larger part of this area is laid out in garden plots which will accommodate about 200 children.

Rose Garden

The Rose Garden, occupying about one acre in the northwest part of the Botanic Garden, was formally opened to the public on Sunday afternoon, June 24, 1928. This garden was made possible by a gift of $10,000, later increased to $15,000, from Mr. and Mrs. Walter V. Cranford, of Greenwich, Connecticut.

The general plan of the Garden is as follows. At the north end, entrance is gained through a Doric pergola. Three parallel rows of beds extend to the southward from the pergola, as far as the pavilion. In the central row of beds, varieties of hybrid perpetuals have been planted along with many of the small *polyantha* type; each of the two side rows contains varieties of hybrid teas. In the location of these varieties the older forms appear at the beginning, near the pergola, the most recent productions near the pavilion, with the intermediate forms in chronological sequence between. Varieties of pillar and post roses are planted at regular intervals, on suitable supports, in the beds, with standards between the beds of the side rows. The trellis surrounding the garden, and also the pergola and pavilion, furnish support for climbing roses, while the marginal beds along the trellis are for wild species and their derivatives. South of the pavilion, three additional beds are devoted to historical roses, *i.e.*, those mentioned in ancient literature, and to roses of commercial use.

The Rose Garden is open to the public from 1 to 5 on weekday afternoons, except holidays. Children are admitted only when accompanied by responsible adults.

Japanese Garden

The Japanese Garden, first opened to the public in 1915, was a gift to the Botanic Garden from Mr. Alfred T. White, "the father of the Botanic Garden." Designed by the Japanese architect, Mr. T. Shiota, it represents truly the Japanese idea of a garden. From the tea house (near the east entrance) one can see the *machiai* or "rest house," the island with the drum bridge, bronze storks, stone and wooden lanterns, the waterfalls, and the wooden Torii standing in the lake. For details and explanations of the meaning of the various features see "The Japanese Garden of the Brooklyn Botanic Garden": Guide No. 4. (*Brooklyn Botanic Garden Record* 19: 197–234. July, 1930.)

Non-Botanical Educational Features

Meridian Panel.—In 1931 there was placed in the paved walk in front of the main west entrance to the Laboratory Building a Terrestrial Position Panel, briefly referred to as the "Meridian Panel." This panel, of black Italian marble terrazzo, is 21 feet, 2 inches long, and 5 feet wide. It contains a brass strip 20 feet long and 7/8 inch wide laid along the geographical meridian, the location of which was accurately determined by Mr. Weld Arnold, then of the School of Surveying of the American Geographical Society, but now of the School of Geography, Harvard University.

Another brass strip, 18½ feet long and 5/8 inch wide, marking the magnetic meridian, crosses the geographical meridian at an angle of 11° 11′. The data at the ends of the meridians are as follows:

At the North End:

Magnetic north. Variation 11° 11′ west in 1931
Annual increase 4′

At the South End:

Altitude above mean sea level, 115 feet
North latitude, 40° 40′ 06″
Longitude west of Greenwich, 73° 57′ 48″
To the North Pole, 3416.7 miles
To the Equator, 2798.2 miles

This feature is proving of much public interest, and the data are constantly being copied by classes and others.

The completion of the large circular compass and sundial, as the central motif of the Laboratory Plaza, awaits available funds which we hope may be contributed in the near future. The amount required is approximately $1,000.

Labelled Boulders.—The Brooklyn Botanic Garden is located near the western end of the terminal moraine of Long Island. This moraine was deposited at the southern edge of the continental glacier that occupied the northern part of North America, during the last Ice Age. The southward-moving ice picked up and carried along innumerable boulders derived from rock ledges in various localities north of what is now Long Island. During their journey, these boulders were rounded and polished and, in some cases, marked with striations that still persist. Twenty-eight of these boulders have had their lithological composition carefully determined and compared with that of rock ledges to the north. By this study it has been possible to determine, with a fair degree of accuracy, the approximate places from which the boulders now in the Botanic Garden were derived by the ice. Bronze tablets, given by Mr. Edward C. Blum, have been placed on these boulders, giving their composition and stating that they were brought to the Garden by the ice-sheet during the glacial period. Guide No. 7, *The story of our boulders,* has been prepared for the use of classes in geography or geology, or others who may be interested, and may be obtained at the Information Desk and Entrance Gates. Arrangements may be made in advance for docents to conduct classes who wish to study these labelled boulders.

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GENERAL INFORMATION

Membership.—All persons who are interested in the objects and maintenance of the Brooklyn Botanic Garden are eligible to membership. Members enjoy special privileges. Annual Membership, $10 yearly; Sustaining Membership, $25 yearly; Life Membership, $500. Full information concerning membership may be had by addressing *The Director, Brooklyn Botanic Garden, 1000 Washington Avenue, Brooklyn, N. Y.* Telephone, Prospect 9-6173.

The Botanic Garden is open free to the public daily from 8 a.m. until dusk; on Sundays and Holidays it is open at 10 a.m.

Entrances.—On Flatbush Avenue, near Empire Boulevard and near Mt. Prospect Reservoir; on Washington Avenue, south of Eastern Parkway and near Empire Boulevard; on Eastern Parkway, west of the Museum Building.

The street entrance to the Laboratory Building is at 1000 Washington Avenue, opposite Crown Street.

To Assist Members and others in studying the collections the services of a docent may be obtained. This service is free of charge to *members of the Botanic Garden;* to others there is a charge of 50 cents per person. Arrangements must be made by application to the Curator of Public Instruction at least one day in advance. No parties of less than six adults will be conducted.

To Reach the Garden take Broadway (B.M.T.) Subway to Prospect Park Station; Interborough Subway to Eastern Parkway-Brooklyn Museum Station; Flatbush Avenue trolley to Empire Boulevard; Franklin Avenue, Lorimer Street, or Tompkins Avenue trolleys to Washington Avenue; St. John's Place trolley to Sterling Place and Washington Avenue; Union Street or Vanderbilt Avenue trolleys to Prospect Park Plaza and Union Street. By Automobile from points on Long Island take Eastern Parkway west and turn left at Washington Avenue; from Manhattan, take Manhattan Bridge, follow Flatbush Avenue Extension and Flatbush Avenue to Eastern Parkway, turn left following Parkway to Washington Avenue; then turn right.

BROOKLYN BOTANIC GARDEN
PUBLICATIONS

RECORD. Established, January, 1912. An administrative periodical issued quarterly (1912–1928); bimonthly beginning with 1929. Contains, among other things, the *Annual Report* of the director and heads of departments, special reports, announcements of courses of instruction, seed list, guides, miscellaneous papers, and notes concerning Garden progress and events. Free to members of the Garden. To others $1.50 a year. Circulates in 59 countries.

MEMOIRS. Established, July, 1918. Published irregularly. Circulates in 47 countries.

Volume I. *Dedication Papers:* comprising 33 scientific papers presented at the dedication of the laboratory building and plant houses, April 19–21, 1917. 521 pages. Price $3.50, plus postage.

Volume II. The vegetation of Long Island. Part I, The vegetation of Montauk: A study of grassland and forest. By Norman Taylor, June 11, 1923. 108 pages. Price $1.00, plus postage.

Volume III. Vegetation of Mount Desert Island, Maine, and its environment. By Barrington Moore and Norman Taylor, June 10, 1927. 151 pages. Price $1.60.

CONTRIBUTIONS. Established, April 1, 1911. Papers originally published in periodicals, reissued as "separates," without change of paging, and numbered consecutively. Twenty-five numbers constitute one volume. Price 25 cents each, $5.00 a volume. Circulates in 34 countries.

62. Physiologic races of Ustilago levis and U. avenae on red oats. 7 pages. 1932.

63. Inheritance of resistance to loose and covered smut in a hybrid of Early Gothland and Victor oats. 10 pages. 1932.

64. Inheritance of resistance to loose and covered smut in hybrids of Hull-less with Early Gothland and Monarch oats. 28 pages. 1932.

LEAFLETS. Established, April 10, 1913. Published weekly or biweekly during April, May, June, September, and October. The purpose of the *Leaflets* is primarily to give announcements concerning flowering and other plant activities to be seen in the Garden near the date of issue, and to give popular, elementary information about plant life for teachers and others. Free to members of the Garden. To others, fifty cents a series. Single numbers 5 cents each. Circulates in 28 countries.

GUIDES to the collections, buildings, and grounds. Price based upon cost of publication. Issued as numbers of the RECORD; see above.

Guide No. 6. Japanese potted trees (Hachinoki). 11 illustrations. Price, 35 cents. By mail, 40 cents.

Guide No. 7. The story of our boulders: Glacial geology of the Brooklyn Botanic Garden. 22 illustrations. Price, 35 cents. By mail, 40 cents.

Guide No. 8. The story of fossil plants. Guide to the transparencies in Conservatory House No. 2. 8 illustrations. Price, 35 cents. By mail, 40 cents.

SEED LIST. (*Delectus Seminum*) Established, December, 1914. Since 1925 issued each year in the January number of the RECORD. Circulation includes 160 botanic gardens and institutions located in 40 countries.

AMERICAN JOURNAL OF BOTANY. Established, January, 1914. Published, in coöperation with the BOTANICAL SOCIETY OF AMERICA, monthly, except during August and September. Subscription, $7.00 a year. Circulates in 53 countries.

ECOLOGY. Established, January, 1920. Published quarterly in coöperation with the ECOLOGICAL SOCIETY OF AMERICA. Subscription, $4.00 a year. Circulates in 48 countries.

GENETICS. Established, January, 1916. Bimonthly. Subscription, $6.00 a year. Circulates in 37 countries.

BROOKLYN BOTANIC GARDEN RECORD

VOL. XXI NOVEMBER, 1932 NO. 6

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BEARING ON THE

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OF THE

BROOKLYN BOTANIC GARDEN

1897–1932

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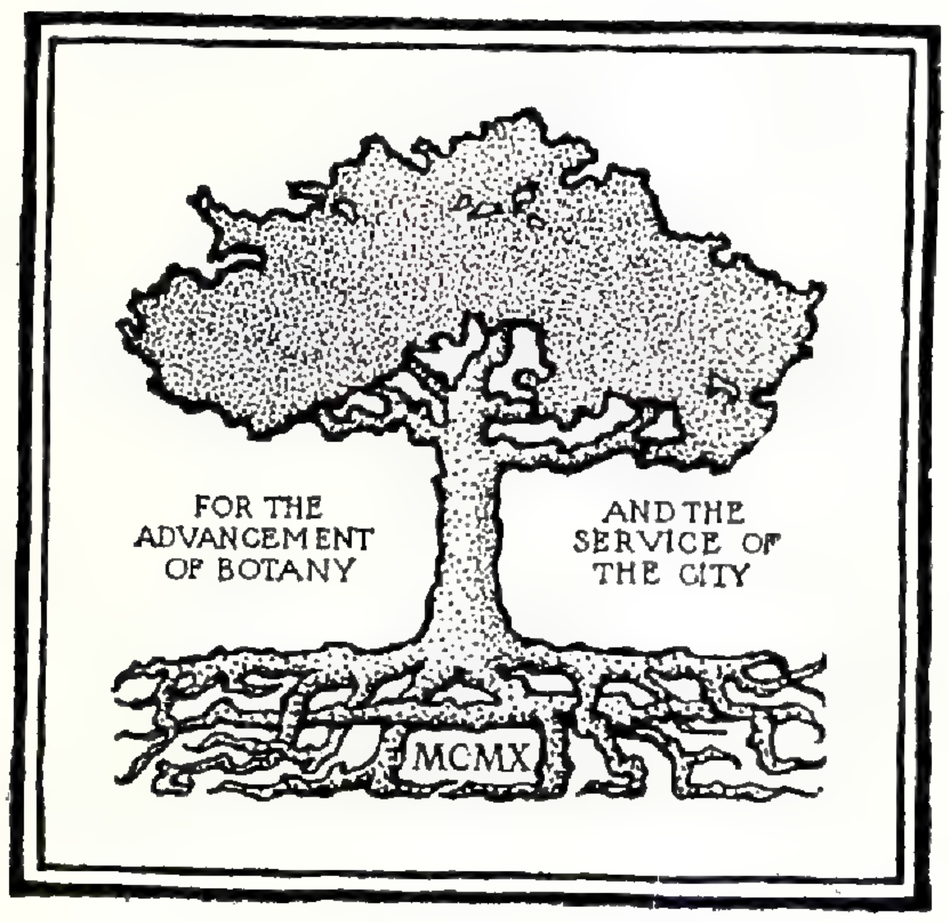

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BROOKLYN BOTANIC GARDEN RECORD

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1897–1932

LAWS OF NEW YORK STATE CONCERNING THE BROOKLYN BOTANIC GARDEN

LAWS OF NEW YORK, 1897. CHAP. 509

AN ACT to provide for the establishment of a botanic garden and arboretum on park lands in the city of Brooklyn, and for the care of the same.

Became a law May 18, 1897, with the approval of the Governor (Frank S. Black). Passed, three-fifths being present.

Accepted by the city.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. The park commissioner of the city of Brooklyn is hereby authorized and required to set apart and appropriate all of that portion of Prospect park bounded northerly by the Eastern parkway, easterly by Washington avenue, southerly by the line formerly dividing the city of Brooklyn from the late town of Flatbush, and westerly by Flatbush avenue, excepting only such lands as have been reserved for the Prospect hill reservoir, as have been leased to the Brooklyn Institute of Arts

Lands to be set apart.

and Sciences, and as have been set apart and designated by the mayor and park commissioner of the city of Brooklyn as a site for the Brooklyn Public library, for the establishing and maintaining thereon of a botanic garden and arboretum for the collection and culture of plants, flowers, shrubs and trees, the advancement of botanical science and knowledge, and the prosecution of original researches therein and in kindred subjects; for affording instruction in the same, and for the prosecution and exhibition of ornamental and decorative horticulture and gardening, and for the entertainment, recreation and instruction of the people, and the said lands so set apart and appropriated shall be used for no other purposes than those authorized by this act.

Objects of the Garden.

Laying out of the Garden.

§ 2. The said park commissioner or his successor or successors is hereby authorized and directed to cause said lands, bounded and described in section one of this act, to be laid out as a botanic garden and arboretum, and as a proper approach to the Museum building of the Brooklyn Institute of Arts and Sciences, by a competent landscape gardener, and on plans approved by the said park commissioner or his successor or successors, and said proper approach to the Museum building shall be subject to the approval of the board of trustees of said institute. And means for the proper construction, planting, equipment, and maintenance of said garden and arboretum shall be provided in the same manner as for the support and maintenance of other park lands in the city of Brooklyn or its successor.

Approach to Museum building.

Means, how provided.

Repeal.

§ 3. All acts or parts of acts inconsistent with this act are hereby repealed.

§ 4. This act shall take effect immediately.

Laws of New York, 1906. Chapter 618

An Act to amend chapter five hundred and nine of the laws of eighteen hundred and ninety-seven, entitled "An act to provide for the establishment of a botanic garden and arboretum on park lands in the city of Brooklyn and for the care of the same."

Became a law, May 24, 1906, with the approval of the Governor (Charles E. Hughes). Passed, three-fifths being present. Accepted by the city.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. Chapter five hundred and nine of the laws of eighteen hundred and ninety-seven, entitled "An act to provide for the establishment of a botanic garden and arboretum on park lands in the city of Brooklyn and for the care of the same," is hereby amended so as to read as follows:

L. 1897, ch. 509, amended.

§ 1. The park commissioner of the city of Brooklyn is hereby authorized and required to set apart and appropriate all of that portion of Prospect park bounded northerly by the Eastern parkway, easterly by Washington avenue, southerly by the line formerly dividing the city of Brooklyn from the late town of Flatbush, and westerly by Flatbush avenue, excepting only such lands as have been reserved for the Prospect hill reservoir, as have been leased to the Brooklyn institute of arts and sciences, and as have been set apart and designated by the mayor and park commissioner of the city of Brooklyn as a site for the Brooklyn public library, for the establishing and maintaining thereon of a botanic garden and arboretum for the collection and culture of plants, flowers, shrubs and trees, the advancement of botanical science and knowledge, and the prosecution of original researches therein and in kindred subjects; for affording instruction in the same, and for the prosecution and exhibition of ornamental and decorative horticulture and gardening, and for the entertainment, recreation and instruction of the people, and the said lands so set apart and appropriated shall be used for no other purposes than those authorized by this act.

Site for botanic garden and arboretum.

Objects of the Garden.

§ 2. Whenever the Brooklyn institute of arts and sciences, incorporated by chapter one hundred and seventy-two of the laws of eighteen hundred and ninety, shall have raised or secured by private subscription the sum of fifty thousand dollars within one year from the passage of this act, the principal of which or the income thereof to be set apart and used by the said institute for the purchase of plants, flowers, shrubs and trees, to be set out in said botanic garden or arboretum, the board of estimate and apportionment of the city of New York, on the recommendation of the board of commissioners of public parks of said city of New York is hereby authorized in its discretion to enter into

Agreement with Brooklyn Institute of Arts and Sciences; conditions.

an agreement on behalf of said city with the said Brooklyn institute of arts and science[1] for the establishing and maintaining by said institute of a botanic garden and arboretum upon such terms and conditions as may be agreed to, on any or all the lands mentioned in section one of this act, excepting thereout the lands designated as a site for a public library by chapter five hundred and fifty-three of the laws of nineteen hundred and five, and on any of the lands lying between Washington avenue and Flatbush avenue acquired by the city of New York and bounded northerly by the line formerly dividing the old city of Brooklyn from the late town of Flatbush, easterly by Washington avenue and southerly and westerly by Flatbush avenue. The plans for the said botanic garden and arboretum shall be subject to the approval of the said board of park commissioners. And said board of commissioners is thereupon hereby authorized to construct and equip, upon the lands designated in said agreement and according to plans to be approved by them and by the trustees of said institute, suitable planthouses for the care and culture of tender or other plants, indigenous or exotic, and rooms for instruction in botany, the use of same upon completion to be transferred to the said Brooklyn institute of arts and sciences for the purposes stated in this act; and for the purpose of providing means therefor it shall be the duty of the comptroller of the city of New York, upon being thereto requested by the said commissioners, and upon being authorized thereto by the board of estimate and apportionment and the board of aldermen of said city, to issue and sell corporate stock of the city of New York in the manner now provided by law aggregating the sum of one hundred thousand dollars.

Lands excepted from site designated.

South addition.

Plans.

Construction of buildings authorized.

Issue of corporate stock of city authorized.

§ 3. No intoxicating liquors shall be sold or allowed on the grounds set apart as above provided. For police purposes and for the maintenance of proper roads and walks, the said grounds shall remain subject at all times to the control of said board of commissioners of the department of parks; but otherwise, after the completion of said planthouses and rooms, and the construction of proper roads and walks therein by the department of parks, the said grounds and buildings shall be under the management and control of said Brooklyn institute of arts and

Intoxicating liquors not to be sold.

Management and control.

[1] So in original.

sciences. Said grounds shall be open and free to the public daily, including Sundays, subject to such restrictions only as to hours as the proper care, culture and preservation of the said garden may require; and its educational and scientific privileges shall be open to all alike, male and female, upon such necessary regulations, terms and conditions as shall be prescribed by the board of trustees of said institute and approved by said board of commissioners of the department of parks.

Grounds to be open free, when and to whom.

Educational and scientific privileges.

§ 4. The board of estimate and apportionment and the board of aldermen of the city of New York on the making of an agreement [2] as provided in section two of this act, are hereby authorized on the recommendation of the said board of park commissioners, in their discretion, to appropriate annually a sum or sums of money, for the care and maintenance by said institute of said botanic garden and arboretum and of the planthouses and rooms for instruction erected thereon.

Annual appropriation for maintenance.

§ 5. This act shall take effect immediately.

Laws of New York, 1911. Chap. 178

An Act to amend chapter five hundred and nine of the laws of eighteen hundred and ninety-seven, entitled "An act to provide for the establishment of a botanic garden and arboretum on park lands in the city of Brooklyn and for the care of the same," generally.

Accepted by the City.

Became a law May 20, 1911, with the approval of the Governor (John A. Dix). Passed by a two-thirds vote.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Chapter five hundred and nine of the laws of eighteen hundred and ninety-seven, entitled "An act to provide for the establishment of a botanic garden and arboretum on park lands in the city of Brooklyn and for the care of the same," as amended by chapter six hundred and eighteen of the laws of nineteen hundred and six, is hereby amended so as to read as follows:

L. 1897, ch. 509, as amended by L. 1906, ch. 618, amended.

[2] See pages 275, 284, and 289 infra.

Site for botanic garden and arboretum.

§ 1. The park commissioner of the city of New York, having jurisdiction of the boroughs of Brooklyn and Queens [3] is hereby authorized and required to set apart and appropriate all that portion of Prospect Park bounded northerly by the Eastern parkway, easterly by Washington avenue, southerly by the line formerly dividing the city of Brooklyn from the late town of Flatbush, and westerly by Flatbush avenue, excepting only such lands as have been reserved for the Prospect Hill reservoir, as have been leased to the Brooklyn Institute of Arts and Sciences,[4] for the establishing and maintaining thereon of a botanic garden and arboretum for the collection and culture of plants, flowers, shrubs and trees, the advancement of botanical science and knowledge, and the prosecution of original researches therein and in kindred subjects; for affording instruction in the same, and for the prosecution and exhibition of ornamental and decorative horticulture and gardening, and for the entertainment, recreation and instruction of the people.[5]

Objects of the Garden.

Agreement with Brooklyn Institute of Arts and Sciences; conditions.

§ 2. Whenever the Brooklyn Institute of Arts and Sciences, incorporated by chapter one hundred and seventy-two of the laws of eighteen hundred and ninety, shall have raised or secured by private subscription the sum of fifty thousand dollars within one year from the passage of this act, the principal of which or the income thereof to be set apart and used by the said institute for the purchase of plants, flowers, shrubs and trees,[6] or for other purposes in connection with said botanic garden and [7] arboretum, the board of estimate and apportionment of the city of New York on the recommendation of the board of commissioners of public parks of the said city of New York is hereby authorized in its discretion to enter into an agreement [8] on behalf

[3] Section to here formerly read: "The park commissioner of the city of Brooklyn." The park departments of the Boroughs of Brooklyn and Queens are now (1932) under separate commissioners.

[4] The words "and as have been set apart and designated by the mayor and park commissioner of the city of Brooklyn as a site for the Brooklyn public library," omitted.

[5] The words "and the said lands so set apart and appropriated shall be used for no other purposes than those authorized by this act," omitted.

[6] The words "to be set out in," omitted.

[7] Formerly "or."

[8] See pages 275, 284, and 289 infra.

of said city with the said Brooklyn Institute of Arts and Sciences for the establishing and maintaining by said institute of a botanic garden and arboretum upon such terms and conditions as may be agreed to, on any or all the lands mentioned in section one of this act, excepting thereout the lands designated as a site for a public library by chapter five hundred and fifty-three of the laws of nineteen hundred and five, and also excepting therefrom such lands as have been designated and set apart by the board of park commissioners and the board of estimate and apportionment of the said city of New York as a site for an astronomical observatory in pursuance of chapter six hundred and thirty-seven of the laws of nineteen hundred and six;[9] and on any of the lands lying between Washington avenue and Flatbush avenue acquired or that may hereafter be acquired[10] by the city of New York and bounded northerly by the line formerly dividing the old city of Brooklyn from the late town of Flatbush, easterly by Washington avenue and southerly and westerly by Flatbush avenue. The plans for the said botanic garden and arboretum shall be subject to the approval of the said board of park commissioners. And said board of commissioners is thereupon hereby authorized to construct and equip, upon the lands designated in said agreement and according to plans to be approved by them and by the trustees of said institute, suitable planthouses for the care and culture of tender or other plants, indigenous or exotic, and rooms for instruction in botany, the use of same upon completion to be transferred to said Brooklyn Institute of Arts and Sciences for the purposes stated in this act, and for the purpose of providing means therefor, and of providing means for grading, soil additions, and other permanent improvements in said garden and arboretum[11] it shall be the duty of the comptroller of the city of New York, upon being thereto requested by the said commissioners, and upon being authorized thereto by the board of estimate and apportionment and the board of aldermen of said city, to issue and sell corporate stock of the city of New York in the manner now provided by law.[12]

Lands excepted from site designated.

Plans.

Construction of buildings authorized.

Issue of corporate stock of city for permanent improvements authorized.

[9] Words "and also excepting therefrom . . . and six," new.
[10] Words "or that may hereafter be acquired," new.
[11] Words "and of providing means . . . and arboretum," new.
[12] Words "aggregating the sum of one hundred thousand dollars," omitted.

Alteration of boundaries of site authorized.

§ 3.[13] And the board of estimate and apportionment of the city of New York, on the recommendation of the board of park commissioners of said city of New York, is hereby authorized in its discretion from time to time to amend the agreement already authorized by chapter six hundred and eighteen of the laws of nineteen hundred and six or to enter into a supplementary agreement or supplementary agreements altering the boundaries of the said botanic garden and arboretum so as to include any

North addition.

portion of the lands now or hereafter reserved for the Prospect Hill reservoir which may be from time to time designated by the commissioner of water supply, gas and electricity, or his successor or successors, as no longer needed for reservoir purposes; and the board of estimate and apportionment of the city of New York is further authorized in its discretion to alter the boundary line between the lands leased by the city of New York to the Brooklyn Institute of Arts and Sciences as a site for a museum of arts and sciences and libraries and lands now leased or that may hereafter be leased by said city to said institute for the purposes of a botanic garden and arboretum as may be agreed to between the said board of estimate and apportionment and the said Brooklyn Institute of Arts and Sciences.

Intoxicating liquors not to be sold.

§ 4.[14] No intoxicating liquors shall be sold or allowed on the grounds set apart as above provided. For police purposes and for the maintenance of proper roads and walks, the said grounds

Management and control.

shall remain subject at all times to the control of said board of commissioners of the department of parks; but otherwise, after the completion of said planthouses and rooms, and the construction of proper roads and walks therein by the department of parks, the said grounds and buildings shall be under the management and control of said Brooklyn Institute of Arts and Sciences.

Grounds shall be open free, when and to whom.

Said grounds shall be open and free to the public daily, including Sundays, subject to such restrictions only as to hours as the proper care, culture and preservation of the said garden may

Educational and scientific privileges.

require; and its educational and scientific privileges shall be open to all alike, male and female, upon such necessary regulations, terms and conditions as shall be prescribed by the board

[13] Section 3 new.

[14] Formerly § 3.

of trustees of said institute and approved by said board of commissioners of the department of parks.

Annual appropriation for maintenance.

§ 5.[15] The board of estimate and apportionment and the board of aldermen of the city of New York on the making of an agreement as provided in paragraph two of this act, are hereby authorized on the recommendation of the said board of park commissioners, in their discretion, to appropriate annually a sum or sums of money for the care and maintenance by said institute of said botanic garden and arboretum and of the planthouses and rooms for instruction erected thereon.

§ 2.[16] This act shall take effect immediately.

AGREEMENT OF DECEMBER 28, 1909, BETWEEN THE CITY OF NEW YORK AND THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES CONCERNING THE BROOKLYN BOTANIC GARDEN

THIS AGREEMENT made and concluded on the 28th day of December, in the year nineteen hundred and nine, between THE CITY OF NEW YORK, acting by its Board of Estimate and Apportionment, party of the first part, and the Brooklyn Institute of Arts and Sciences, party of the second part, WITNESSETH:

Authorizing Legislation

WHEREAS, by an act of Legislature of the State of New York, known as Chapter 618 of the Laws of 1906, entitled "An Act to amend Chapter 509 of the Laws of 1897," entitled "An Act to provide for the establishment of a botanic garden and arboretum on park lands in the City of Brooklyn, and for the care of the same," the party of the first part, acting by its Board of Estimate and Apportionment, is expressly authorized to enter into a contract, on the recommendation of the Board of Commissioners of Public Parks of said City of New York, with the said Brooklyn Institute of Arts and Sciences, party of the second part, for the establishing and maintaining by said Institute of a botanic garden and arboretum on any or all of certain lands described and set forth in said act, and

Private Endowment

WHEREAS, the party of the second part has raised or secured by private subscription, the sum of Fifty thousand dollars within one year from the

[15] Formerly § 4.

[16] So in the original.

passage of said act, the principal of which sum, or the income thereof, is to be set apart and used exclusively by said Institute, party of the second part, for the purchase of plants, flowers, shrubs and trees to be set out in said botanic garden and arboretum; and

WHEREAS, the party of the first part desires that the party of the second part shall have charge of the establishment, development and administration of said botanic garden and arboretum for the benefit of the residents of said city; and said party of the second part is willing to take charge of the establishment, development and administration of said botanic garden and arboretum upon the terms and conditions herein set forth;

NOW, THEREFORE, in consideration of the actions already taken under said Chapter 618 of the Laws of 1906, and in consideration of the mutual agreements herein contained, it is agreed by and between the said parties as follows; viz.:

Lease and Boundaries of the Garden

FIRST.—That the party of the first part has granted and demised and doth by these presents grant, demise, and let unto the said party of the second part the park lands lying between Eastern Parkway on the north; Washington Avenue on the east; the line of division between the old town of Flatbush and the old City of Brooklyn on the south; and Flatbush Avenue on the west (excepting therefrom lands reserved for the Prospect Heights Reservoir; lands leased to the Brooklyn Institute of Arts and Sciences for museum purposes; lands designated as a site for a public library, under Chapter 503 of the Laws of 1905, and land designated and set apart by the party of the first part as a site for an astronomical observatory, under Chapter 637 of the Laws of 1906), bounded and described as follows: Beginning on the easterly side of Flatbush Avenue where the northerly side of President Street, if prolonged, would intersect the easterly side of Flatbush Avenue; running thence easterly along the northerly side of old President Street 300 feet 3½ inches; thence in a southerly direction at right angles to said old President Street 130 feet 1½ inches; thence in an easterly direction parallel to the northerly side of old President Street 180 feet; thence in a northerly direction at right angles to old President Street 130 feet 1½ inches to the northerly line of said President Street; thence along the northerly side of old President Street in an easterly direction 244 feet 2½ inches to the westerly side of old Grand Avenue; thence southerly along the westerly side of old Grand Avenue 170 feet; thence easterly on a line parallel with the northerly side of old President Street 834 feet 7½ inches to the westerly side of Washington Avenue; thence southerly along the westerly side of Washington Avenue 1,110 feet 7½ inches; thence in a southwesterly direction along the line formerly separating the old town of Flatbush from the old City of Brooklyn 746 feet 4 inches to the easterly side of Flatbush Avenue; thence along the easterly side of Flatbush Avenue 2,643 feet 5 inches to the point or place of beginning. All dimensions being more or less; and any building or buildings erected, or that may be erected on the said lands heretofore described, and any equipment of said building or buildings now provided or that may be provided by the party of the first part, to have

and to hold the same so long as the said party of the second part shall continue to carry out the objects and purposes defined in its present charter, or any amendment of said charter, and shall maintain and administer on said lands a botanic garden and arboretum as provided in Chapter 618 of the Laws of 1906; and shall faithfully keep, perform and observe the covenants and conditions herein contained on its part, to be kept, performed and observed until said land and the building or buildings erected thereon shall be surrendered by the said party of the second part as hereinafter provided. A map or diagram of the land covered by this agreement is appended herewith.

Limitations of Use of Property

SECOND.—That as soon as practicable after the execution of this agreement, and upon a date to be mutually agreed upon by the parties hereto, the party of the first part agrees to transfer, in accordance with the authority granted by said Chapter 618 of the Laws of 1906, and the party of the second part agrees to take over said land and any building or buildings thereon, and the equipment of the same, and from and after said date the party of the second part shall have the exclusive use of the whole of said land, and of any building or buildings and equipments located thereon subject to the provisions herein contained, and without any other limitation whatever during the continuance of the term hereby granted, or until the surrender thereof as herein provided.

Plans and Development

THIRD.—That plans for said botanic garden and arboretum shall be prepared as soon as possible after the execution of this agreement, and upon their approval by the Board of Park Commissioners of said City of New York, the party of the second part shall proceed to establish, develop and maintain on the said land a botanic garden and arboretum in accordance with said plans.

Use of Buildings

FOURTH.—That upon the completion of any plant house or plant houses, or rooms for instruction in botany on said land by the party of the first part, acting through its Board of Park Commissioners, the Brooklyn Institute of Arts and Sciences shall enter into possession of said plant house or houses, and rooms for instruction, and shall use the same in connection with, or as a part of said botanic garden and arboretum for the care and culture of tender or other plants, indigenous or exotic, and for the giving of instruction in botany to the residents of the City of New York, in accordance with the provisions of Section 2 of said Chapter 618 of the Laws of 1906.

Loss by Fire, and Repairs

FIFTH.—That neither the party of the first part, its successor or successors, shall be in any manner chargeable or liable for the preservation of said plant house or plant houses, or rooms for instruction, or other structures, or for the machinery or equipment, or contents thereof, or for the property of the party of the second part which may be placed in said botanic garden and arboretum covered or included within this agreement, or in any buildings,

erected thereon against fire nor for any damage or for injury which may be caused by fire to said property; but it is agreed that the damages aforesaid excepted, the said party of the first part shall make, at its own cost and expense such changes, repairs, alterations and renewals in the buildings, machinery, and stationary equipment of the same, as may from time to time be agreed upon between the party of the first part, acting by its Commissioner of Parks for the Boroughs of Brooklyn and Queens, and the party of the second part; and all such changes, repairs, alterations or renewals shall be made upon plans and specifications provided by the party of the first part and approved by the party of the second part.

Annual Maintenance

SIXTH.—That the said party of the first part hereby agrees FROM AND AFTER JANUARY 1, 1910, to provide or appropriate annually for the use of the party of the second part, such sum or sums of money AS MAY SEEM TO THE SAID PARTY OF THE FIRST PART TO BE NECESSARY FOR PROPER MAINTENANCE; and it is expressly understood and agreed by and between the parties hereto that such sum or sums so appropriated shall be expended by the party of the second part for the care and maintenance of said botanic garden and arboretum, its grounds, buildings, apparatus, library and collections; for heating its buildings and for lighting its buildings and grounds; for the payment of salaries of a Botanist and his assistants, and necessary officers of administration; for the payment of wages of all employees required to properly care for and maintain the said botanic garden and arboretum, its equipment and collections; for furnishing books, charts and other publications relating to botany and required for use in connection with the said botanic garden and arboretum; for the cost of cases, racks, frames, supports and other means of preserving and exhibiting publications, photographs and apparatus; for the purchase of photographic apparatus and materials, supplies, labels, pottery and utensils required in the proper administration of the botanic garden and arboretum and for the purchase of soil, fertilizers and other materials required for the proper culture, care and protection of plants grown in said botanic garden and arboretum, and for the publication of reports on the scientific and educational work carried on in connection therewith, and the cost of making or printing annual or other reports desired or required by the party of the first part.

Status of Property variously Owned

SEVENTH.—That all property purchased by funds belonging to the party of the second part, or otherwise acquired by the party of the second part and placed by it in said botanic garden and arboretum shall continue to remain absolutely the property of the party of the second part and may be sold, loaned, exchanged or removed by it at any time, excepting only plants, trees, or shrubs set in the soil of said botanic garden and arboretum, subject, however, to the provisions in this agreement contained; and that the party of the second part may at any time sell or exchange photographs, publications, implements and appliances acquired or purchased with money

supplied by the party of the first part, provided, however, that the net proceeds of such sales or exchanges shall be devoted by the party of the second part solely to the benefit or increase of the apparatus, library, or equipment or maintenance of said botanic garden and arboretum.

Public Exhibits: Material for Public Schools

EIGHTH.—That the party of the second part is hereby expressly authorized to exhibit photographs, charts, apparatus or publications relating to botany, in this city or elsewhere, in the public schools or otherwise, for educational or scientific purposes, provided, however, that all the net proceeds, if any, of such exhibitions shall be devoted solely to the benefit or increase of the library, the apparatus and equipment of the botanic garden and arboretum, and said party of the second part shall, so far as any surplus resources will permit, furnish plants or botanic material for use in the teaching of botany in the public schools of The City of New York, and in case the supply of plants or materials for instruction is not exhausted by the demand of the public schools of the City, such plants and botanic materials may, at the discretion of the party of the second part be furnished to other educational institutions within said City.

Free Admission to Grounds and Buildings

NINTH.—It is mutually understood and agreed that said botanic garden and arboretum shall be open and accessible to the public without any charge or gratuity on a portion at least, of every day of the year, under such rules and regulations as the party of the second part may from time to time prescribe; but it is expressly understood and agreed that the party of the second part shall have the privilege of closing the plant houses or rooms for instruction to the public until 2 o'clock in the afternoon on two days in the week for the purpose of scientific research and for the cleaning or re-arranging of collections or apparatus in said plant houses and rooms of instruction. Admission to said houses and rooms of instruction during such closed hours shall be regulated by the party of the second part, but all professors and teachers in the public and private schools or other institutions of learning in New York City, and pupils accompanied by said teachers, shall be admitted on such closed days, subject to the rules and regulations of the party of the second part; but in no case shall there be any charge for the use of the plant houses or rooms for instruction, or for the use of the library, collections, plants or apparatus contained therein.

Annual Report

TENTH.—The party of the second part shall yearly, during the continuance of this agreement, include in its annual report on said botanic garden and arboretum a detailed statement of the operations and transactions of the said party of the second part in relation to said garden and arboretum, and all its receipts and expenses in relation thereto for the fiscal year next preceding, and shall transmit such report to the party of the first part, its successor or successors.

Access to Property and Records

ELEVENTH.—The party of the first part shall have at all times access to every part of said garden and arboretum and to all buildings erected thereon for the purpose of police visitation and supervision, and for the performance of duties devolved upon it by law; and all books, vouchers and accounts relating to the garden and arboretum, or to anything contained therein, shall at all times be open to the inspection of the party of the first part.

Water Supply: Police Protection: Roadways, Walks, Stone Steps

TWELFTH.—The party of the first part hereby agrees to furnish at all times an adequate supply of aqueduct water and adequate police protection; and to construct and keep in repair roadways, walks and stone steps that may be required or be used in said garden and arboretum, or as an approach thereto.

Co-operation with Local Schools: Public Lectures

THIRTEENTH.—The party of the second part hereby agrees to afford such facilities as its resources may be found to permit and as may be compatible with the proper administration of the garden and arboretum and the interests of the public, to teachers and students in the public or private schools of the city, and to other residents of the city, for the study of botany, and for that purpose to permit teachers in the schools of the city who may be duly authorized by the party of the second part to bring their students to the botanic garden and arboretum where, under the supervision of the proper officers of the garden, instruction may be given to such students in the rooms provided therefor, or in the plant houses or grounds of the garden, at such times and under such regulations as may be determined by the party of the second part; and further to supplement such instruction through lectures by the officers of the botanic garden, or by instructors especially employed for such purpose.

Appointments, Salaries, General Management

FOURTEENTH.—It is expressly understood and agreed that the party of the second part shall have absolute power to appoint, direct, control and remove all persons employed in or about said garden and arboretum and to fix and adjust the salaries of all such persons, and shall be responsible for the same; and the party of the second part shall have power to make all rules and regulations respecting duties for all its employees in and about said garden and arboretum, and the general management and administration of the same, together with its collections, without any restrictions or limitations whatsoever, except as in this agreement contained.

Expeditions: Travelling Expenses

FIFTEENTH.—It is expressly understood and agreed that the Chief Botanist of the garden and arboretum and his assistants shall be given the opportunity to visit other botanic gardens and arboretums within a reasonable distance, and to make expeditions for the purpose of collecting plants for the garden and arboretum and the herbarium of the same; the necessary travelling

expenses of said Chief Botanist and of his assistants to be paid from the annual maintenance fund provided by the party of the first part; and the salaries of said Chief Botanist and his assistants shall be continued during such visits or expeditions; but that no moneys provided by the party of the first part shall be expended in connection with such visits or expeditions that have not been expressly appropriated by the party of the first part for such specific purposes.

Investigation: Advancement of Botanical Science

SIXTEENTH.—It is expressly understood and agreed that the Chief Botanist and one or more assistants shall make botanic researches from time to time, and that they shall labor to the best of their ability for the advancement of botanical science, but that the use of said garden for scientific research shall not interfere with its use by the public and private schools and of the public generally for the purpose of general education or enlightenment, except that a limited space in the building containing the rooms for instruction may be designated by the party of the second part to be used exclusively for research purposes.

Jurisdiction of Commissioner of Parks

SEVENTEENTH.—It is expressly understood and agreed that the botanic garden and arboretum, established and maintained on park lands in the Borough of Brooklyn, shall be under the general jurisdiction of the Park Commissioner of the Boroughs of Brooklyn and Queens, and that application made by the party of the second part for annual maintenance or for changes, repairs, alterations or renewals to structures in said garden and arboretum, or their equipments, shall be made by the party of the second part to the Park Commissioner of the Boroughs of Brooklyn and Queens.

Electric Light and Power

EIGHTEENTH.—It is expressly understood and agreed that the necessary electric current required for the lighting of the botanic garden and arboretum, the plant houses and the building containing the instruction rooms located therein, and the necessary electric power required for the ventilation of the plant houses and rooms of instruction, may be provided, wholly or in part, from the power plant of the Museum of the Brooklyn Institute of Arts and Sciences, situated on adjacent park lands leased to the said Institute, party of the second part; that metal pipes or conduits may be laid between the power plant of said museum to the grounds, the plant houses and the building containing instruction rooms, such pipes to contain wires to convey electric current for lighting and ventilating as hereinbefore described; and that the cost of furnishing electric current or electric power from the power plant of said museum shall be a part of the annual maintenance fund of the botanic garden and arboretum, paid by the party of the first part to the party of the second part.

Brooklyn Institute Herbarium and Collections

NINETEENTH.—That the party of the second part herewith agrees that the herbarium of the Institute and other botanical collections contained

in the museum of the Institute, Eastern Parkway and Washington Avenue, shall be used by the Institute in carrying out its plan and purposes in establishing, developing and maintaining a botanic garden and arboretum for the benefit of the residents of the City of New York.

Quittal and Surrender of Premises

TWENTIETH.—That the said party of the second part may at any time after the expiration of three and before the expiration of six months of the date of the service of a notice in writing to the said party of the first part, its successor or successors, or to the Mayor of the City of New York, of its intention so to do, quit and surrender the said premises and remove all its property therefrom, except as hereinbefore provided; and upon and after such notice said party of the second part shall and will, at the expiration of said six months, quietly and peaceably yield up and surrender to the party of the first part, its successor or successors, all and singular the aforesaid demised premises, and it is expressly understood and agreed by and between the parties hereto that if the party of the second part shall omit to do, perform, fulfill and keep any of the covenants, articles, clauses and agreements, matters and things herein contained, which on its part are to be done, performed, fulfilled and kept according to the true intent and meaning of these presents, then and from thenceforth this grant and demise shall be utterly null and void.

Conditions of Cancellation of Agreement

TWENTY-FIRST.—It is hereby expressly agreed that this contract may be cancelled and annulled at any time by the party of the first part, providing the Board of Estimate and Apportionment of the party of the first part, its successor or successors, after notice in writing to the party of the second part served by mailing or otherwise notifying the party of the second part that some action is to be taken in reference to this agreement, by a vote of three-fourths of all its members by motion or resolution decides that it is for the best interests of the party of the first part that said contract be cancelled or annulled. And it is further agreed that upon said Board of Estimate and Apportionment aforesaid directing the cancellation or annulment of said contract, the party of the first part shall serve upon the party of the second part, or its successor or successors, or any officer thereof, a notice in writing notifying the said party of the second part of the action of the said Board of Estimate and Apportionment, and the said party of the second part shall thereafter, and before the expiration of six months after the date of the service of said notice in writing as aforesaid, notifying the party of the second part of the cancellation or annulment of the contract by the party of the first part, quit and surrender the said premises and remove all of its property therefrom, except as hereinbefore provided, and after such notice, said party of the second part shall and will at or before the expiration of six months, quietly and absolutely yield up and surrender to the party of the first part, its successor or successors, all and singular the aforesaid demised premises, and upon the failure of the party of the second part to remove from said premises all its property and surrender and quit said premises as aforesaid, within six months

after the service of notice as aforesaid, the said party of the first part shall have the right to enter in and upon said premises and take possession of same, together with all property of every kind, nature and description remaining thereon.

Agreement to Cancel or Modify

TWENTY-SECOND.—And it is further understood and agreed by and between the parties hereto that this agreement may be wholly cancelled or annulled, or from time to time be modified, as may be mutually agreed in writing, between said parties, or their successor or successors, anything herein contained to the contrary in any wise notwithstanding.

Adoption of Agreement by Both Parties

IN WITNESS WHEREOF the party of the first part has caused this agreement to be executed by its Mayor, and pursuant to a resolution of the Board of Estimate and Apportionment adopted at a meeting on the 10th day of December in the year of our Lord, 1909; and the said party of the second part has caused the same to be executed by its President and Treasurer and its official seal affixed thereto, pursuant to a resolution of the Board of Trustees of the Brooklyn Institute of Arts and Sciences adopted at a meeting held the 8th day of June in the year of our Lord, 1906.

GEORGE B. MCCLELLAN,
Mayor of The City of New York.

SEAL

A. AUGUSTUS HEALY,
President of the Brooklyn Institute of Arts and Sciences.

SEAL

G. D. FAHNESTOCK,
Treasurer of the Brooklyn Institute of Arts and Sciences.

ATTEST:

P. J. SCULLY,
City Clerk of the City of New York.

Approved as to form,

GEORGE L. STERLING,
Acting Corporation Counsel.

AGREEMENT OF SEPTEMBER 9, 1912, BETWEEN THE CITY OF NEW YORK AND THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, AMENDING THE AGREEMENT OF DECEMBER 28, 1909, TOUCHING THE BROOKLYN BOTANIC GARDEN *

THIS AGREEMENT, made and concluded on the 9th day of September, in the year nineteen hundred and twelve, between The City of New York, acting by its Board of Estimate and Apportionment, party of the first part, and the Brooklyn Institute of Arts and Sciences, party of the second part, witnesseth:

WHEREAS, The City of New York, acting by its Board of Estimate and Apportionment, party of the first part, and the Brooklyn Institute of Arts and Sciences, acting by its Board of Trustees, party of the second part, entered into an agreement on the 28th day of December, in the year 1909, for the establishment and maintenance of a Botanic Garden and Arboretum on park lands in the Borough of Brooklyn, City of New York, and for the care of the same, in accordance with the terms and conditions as expressed in said agreement, and under authority granted to the said City of New York by chapter 618 of the Laws of 1906; and

WHEREAS, Said chapter 618 of the Laws of 1906 has been amended [1] by chapter 178 of the Laws of 1911, entitled "An Act to amend Chapter 509 of the Laws of 1897, entitled 'An Act to provide for the establishment of a Botanic Garden and Arboretum on Park Lands in the City of Brooklyn, and for the care of the same,'" generally; and

WHEREAS, The Commissioner of the Department of Water Supply, Gas and Electricity having certified to the Commissioners of the Sinking Fund, under date of August 5, 1911, that two parcels of Prospect Heights Reservoir Land hereinafter described are no longer needed for reservoir purposes; and

WHEREAS, The Board of Park Commissioners of The City of New York, on December 14, 1911, recommended to the Commissioners of the Sinking Fund that the same two parcels of land hereinafter described be transferred to the custody of the Department of Parks for use as a Botanic Garden and Arboretum; and

* This Amendment was executed in triplicate, and one copy deposited with the Secretary of the Board of Estimate and Apportionment, one with the Comptroller of the City of New York, and one with the Treasurer of the Brooklyn Institute of Arts and Sciences.

By the terms of this Agreement two parcels of Mt. Prospect Reservoir land, since known as the "North Addition," were assigned to the Botanic Garden, and the Garden authorities were empowered to use the income of the original $50,000 of private funds not only "for the purchase of plants, flowers, shrubs, and trees," as restricted in the original Agreement of 1909, but also "for other purposes in connection with said Botanic Garden and Arboretum."

[1] See p. 271.

WHEREAS, The Commissioners of the Sinking Fund of The City of New York, on January 10, 1912, transferred the said two parcels of land hereinafter described to the Department of Parks of the Borough of Brooklyn for use as a Botanic Garden and Arboretum through the passing of the following resolution:

RESOLVED, That, pursuant to the provisions of Section 205 of the Greater New York Charter, as amended, the Commissioners of the Sinking Fund hereby assign to the Department of Parks, Borough of Brooklyn, for the establishment of a Botanic Garden and Arboretum, property bounded and described as follows:

First Parcel

Beginning at the southwesterly corner of old Grand avenue and old Sackett street as formerly laid out on the Commissioner's map of the County of Kings, and continuing in a southerly direction along the west side of said Grand avenue to the northerly side of old President street, as formerly laid out on said map, for a distance of 594 feet, more or less; thence in a westerly direction along the northerly side of said old President street to the easterly side of Flatbush avenue 725 feet, more or less; thence northerly along the easterly side of Flatbush avenue for a distance of 27.94 feet, more or less, to a point where a line parallel to the northerly side of old President street and 20 feet north of said line intersects the easterly side of Flatbush avenue, and thence in an easterly direction along said line parallel to President street, to a point situated 20 feet from the northerly side of old President street and 250 feet west of the westerly side of Grand avenue; and thence in a northerly direction parallel to the westerly side of said old Grand avenue to the southerly side of old Sackett street, a distance of 574 feet; thence in an easterly direction along the southerly line of old Sackett street, a distance of 250 feet, to the westerly side of old Grand avenue at the point of beginning.

Second Parcel

Beginning at the southwesterly corner of Grand avenue and Sackett street, as formerly laid out on the Commissioner's map of the County of Kings and continuing in a westerly direction along the southerly side of Sackett street 250 feet to a point; thence northerly and parallel to Grand avenue to a point on the southerly side of the Eastern parkway; thence in an easterly direction along the southerly side of the Eastern parkway to its intersection with the westerly side of Grand avenue; thence southerly along the westerly side of Grand avenue 18 feet to the point of beginning.

—said assignment being made under the following conditions:

First—That the iron fence shall be rebuilt by the Park Department or the Botanic Garden along the easterly side of the remaining reservoir property, and if the adjoining lands shall be graded to a lower elevation, a slope of 2 to 1 shall be left with a berm of sufficient width to secure the stability of the fence, and means of access to the reservoir property by vehicles shall be provided to the lower berm on the north side of the reservoir and to the roadway at the south side of the reservoir.

Second—The Department of Water Supply, Gas and Electricity intends to erect an office and tool house approximately 20 feet by 30 feet at a location to be hereafter designated by the Commissioner of said Department, and the right is hereby reserved, therefore, to use any portion of the lands herein designated and described, and to be assigned to the Park Department that the Commissioner of the Department of Water Supply, Gas and Electricity may consider necessary for the erection of said office and tool house.

Third—The lands to be assigned to the Department of Parks shall be reassigned to the Department of Water Supply, Gas and Electricity upon the certification of the Commissioner of Water Supply, Gas and Electricity that said lands are needed for the extension or improvement of the water supply system.

Fourth—No buildings shall be erected by the Department of Parks on any of the lands hereby assigned without the written consent of the Commissioner of the Department of Water Supply, Gas and Electricity, as set forth in said instrument of designation dated August 5, 1911; and

WHEREAS, The Board of Park Commissioners of The City of New York has on the 27th day of March, 1912, recommended to the said Board of Estimate and Apportionment that the agreement entered into between the party of the first part and the party of the second part under the authority of chapter 618 of the Laws of 1906, said agreement being dated December 28, 1909, be amended as hereinafter set forth and as provided in section 3 of chapter 178 of the Laws of 1911:

NOW, THEREFORE, in consideration of the actions already taken under chapter 618 of the Laws of 1906, chapter 178 of the Laws of 1911, and section 205 of the Greater New York Charter, as amended, and in consideration of the mutual agreements herein contained, it is agreed by and between the said parties that the agreement between the said City of New York and the said Brooklyn Institute of Arts and Sciences, entered into on December 28, 1909, be hereby amended as follows, namely:

First—That the party of the first part has granted and demised, and doth by these presents grant, demise and let unto the said party of the second part the two parcels of land heretofore pertaining to the Prospect Hill Reservoir hereinbefore described and bounded; said two parcels of land to be added to the lands of the Brooklyn Botanic Garden and Arboretum leased to the Brooklyn Institute of Arts and Sciences on December 28, 1909, the said Institute, party of the second part, to have and to hold the same so long as the said party of the second part shall continue to carry out the objects and purposes defined in its Charter, or any amendment of said Charter, except as herein or as in the aforesaid agreement of December 28, 1909, otherwise provided, and shall maintain and administer these two said parcels of land hereinbefore bounded and described for the purposes of a Botanic Garden and Arboretum as provided in chapter 178 of the Laws of 1911; and shall faithfully keep, perform and observe the covenants and conditions herein contained on its part to be kept, performed and observed until said land shall be surrendered by the said party of the second part, or its surrender is required by the party of

the first part as provided in the original agreement, dated December 28, 1909, and as further provided in this agreement; and the said two parcels of land shall be used and held by the party of the second part under the same terms and conditions in all respects as the lands leased by the party of the first part to the said party of the second part on December 28, 1909, with the following exceptions and conditions:

1. That the iron fence shall be rebuilt by the Park Department or the Botanic Garden along the easterly side of the remaining reservoir property, and if the adjoining lands shall be graded to a lower elevation, a slope of 2 to 1 shall be left with a berm of sufficient width to secure the stability of the fence, and means of access to the reservoir property by vehicles shall be provided to the lower berm on the north side of the reservoir and to the roadway at the south side of the reservoir.

2. The Department of Water Supply, Gas and Electricity intends to erect an office and tool house approximately 20 feet by 30 feet at a location to be hereinafter designated by the Commissioner of said Department, and the right is hereby reserved, therefore, to use any portion of the lands herein designated and described and to be assigned to the Park Department that the Commissioner of the Department of Water Supply, Gas and Electricity may consider necessary for the erection of said office and tool house.

3. The lands to be assigned to the Department of Parks shall be reassigned to the Department of Water Supply, Gas and Electricity upon the certification of the Commissioner of Water Supply, Gas and Electricity that said lands are needed for the extension or improvement of the water supply system.

4. No buildings shall be erected by the Department of Parks on any of the lands hereby assigned without the written consent of the Commissioner of the Department of Water Supply, Gas and Electricity, as set forth in said instrument of designation dated August 5, 1911.

And the party of the first part herein agrees to provide such sums as the Board of Estimate and Apportionment may deem necessary for the cost of the necessary grading, soil additions, and other permanent improvements and for the annual maintenance of said lands, in the same manner that it provides for other permanent improvements and for maintenance in the Botanic Garden and Arboretum heretofore established through the said agreement dated December 28, 1909, and in pursuance of authority granted by said chapter 178 of the Laws of 1911.

Second—And the party of the second part now holding the sum of $50,000.00, the principal or interest of which is to be expended for the benefit of the said Botanic Garden and Arboretum, is privileged after the date of the execution of this agreement, in pursuance of authority granted in section 2 of said chapter 178 of the Laws of 1911, to use the income thereof for the purchase of plants, flowers and trees, or for other purposes in connection with said Botanic Garden and Arboretum.

And it is hereby expressly agreed that this contract may be cancelled and annulled at any time by the party of the first part, providing the Board of Estimate and Apportionment of the party of the first part, its successor or

successors, after notice in writing to the party of the second part, served by mailing or otherwise, notifying the party of the second part that some action is to be taken in reference to this agreement, by a vote of three-fourths of all its members, by motion or resolution decide that it is for the best interests of the party of the first part that said contract be cancelled or annulled. And it is further agreed that upon said Board of Estimate and Apportionment aforesaid directing the cancellation or annullment of said contract, that the party of the first part shall serve upon the party of the second part, or its successor or successors, or any officer thereof, a notice in writing notifying the said party of the second part of the action of the said Board of Estimate and Apportionment, and the said party of the second part shall thereafter, and before the expiration of six months after the date of the service of said notice in writing, as aforesaid, notifying the party of the second part of the cancellation or annullment of the contract by the party of the first part, quit or surrender the said premises and remove all of its property therefrom except as hereinbefore provided, and after such notice said party of the second part shall and will at or before the expiration of six months, quietly and absolutely yield up and surrender to the party of the first part, its successor or successors, all and singular the aforesaid demised premises, and upon the failure of the party of the second part to remove from said premises all its property and surrender and quit said premises as aforesaid, within six months after the service of notice as aforesaid, the said party of the first part shall have the right to enter in and upon said premises and take possession of same, together with all property of every kind, nature and description remaining thereon.

And it is further understood and agreed by and between the parties hereto that this agreement may be wholly cancelled or annulled, or from time to time be modified as may be mutually agreed in writing between said parties, or their successor or successors, anything herein contained to the contrary in anywise notwithstanding.

IN WITNESS WHEREOF the party of the first part has caused this agreement to be executed by its Mayor, pursuant to a resolution of the Board of Estimate and Apportionment adopted at a meeting held on the 11th day of July, in the year of our Lord nineteen hundred and twelve, and the said party of the second part has caused the same to be executed by its President and Treasurer, and its official seal affixed thereto, pursuant to a resolution of the Board of Trustees of the Brooklyn Institute of Arts and Sciences adopted at a meeting held on the 8th day of March, in the year of our Lord nineteen hundred and twelve.

CITY OF NEW YORK,

WILLIAM J. GAYNOR, *Mayor.*

BROOKLYN INSTITUTE OF ARTS AND SCIENCES,

A. AUGUSTUS HEALY, *President.*

[SEAL] CLINTON W. LUDLUM, *Treasurer.*

Approved as to form:

JOHN L. O'BRIEN, *Acting Corporation Counsel.*

BOARD OF ESTIMATE AND APPORTIONMENT CITY OF NEW YORK

Resolved, That, pursuant to the provisions of chapter 618 of the Laws of 1906, as amended by chapter 178 of the Laws of 1911, the Board of Estimate and Apportionment hereby approves of the amended agreement submitted by the Park Board of The City of New York, between The City of New York, acting by the Board of Estimate and Apportionment, and the Brooklyn Institute of Arts and Sciences, relative to the establishment and maintenance of a Botanic Garden and Arboretum on park lands in the Borough of Brooklyn, under the jurisdiction of said Institute of Arts and Sciences, and the Mayor be and is hereby authorized to execute said agreement on behalf of The City of New York.

A true copy of resolution adopted by the Board of Estimate and Apportionment, July 11, 1912.

JOSEPH HAAG,
Secretary.

AGREEMENT OF AUGUST 17, 1914, BETWEEN THE CITY OF NEW YORK AND THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, AMENDING THE AGREEMENT OF SEPTEMBER 9, 1912, WHICH AMENDED THE AGREEMENT OF DECEMBER 28, 1909, TOUCHING THE BROOKLYN BOTANIC GARDEN *

BOARD OF ESTIMATE AND APPORTIONMENT, CITY OF NEW YORK

THIS AGREEMENT, made and concluded on the 17th day of August, in the year nineteen hundred and fourteen, between The City of New York, acting by its Board of Estimate and Apportionment, party of the first part, and the Brooklyn Institute of Arts and Sciences, acting by its Board of Trustees, part of the second part, witnesseth:

* This amendment was executed in triplicate, and one copy deposited with the secretary of the Board of Estimate and Apportionment, one with the Comptroller of the City of New York, and one with the treasurer of The Brooklyn Institute of Arts and Sciences.

By the terms of this Agreement the area of about eight acres of land lying opposite the Willink Entrance to Prospect Park, and since known as the "South Addition," was assigned to the Botanic Garden. This extended the Botanic Garden land southward to Malbone St. (now Empire Boulevard). The other terms of the Agreement remained essentially unaltered.

Original Act and Agreement

WHEREAS, The City of New York, acting by its Board of Estimate and Apportionment, party of the first part, and the Brooklyn Institute of Arts and Sciences, acting by its Board of Trustees, party of the second part, entered into an agreement on the 28th day of December, in the year 1909, for the establishment and maintenance of a botanic garden and arboretum on park lands in the Borough of Brooklyn, City of New York, and for the care of the same, in accordance with the terms and conditions as expressed in said agreement, and under authority granted to the said City of New York by chapter 509 of the Laws of 1897 and chapter 618 of the Laws of 1906; and

Amendment of the Act of 1897

WHEREAS, Said chapter 618 of the Laws of 1906 has been amended by chapter 178 of the Laws of 1911, entitled "An Act to amend chapter 509 of the Laws of 1897, entitled 'An Act to provide for the establishment of a botanic garden and arboretum on park lands in the City of Brooklyn, and for the care of the same,'" generally; and

First Amendment of Original Agreement of 1909

WHEREAS, Said agreement, entered into on the 28th day of December, 1909, was amended on September 9, 1912, in pursuance of authority granted by said chapter 178 of the Laws of 1911; and

Provisions of the Act of 1911

WHEREAS, Chapter 178 of the Laws of 1911 in section II, authorizes the Board of Estimate and Apportionment of The City of New York in its discretion on the recommendation of the Board of Commissioners of Public Parks of the said City, to enter into an agreement on behalf of said City with the Brooklyn Institute of Arts and Sciences for the establishing and maintaining by the said Institute of a botanic garden and arboretum upon such terms and conditions as may be agreed to, on "any of the lands lying between Washington avenue and Flatbush avenue acquired or that may hereafter be acquired by the City of New York and bounded northerly by the land formerly dividing the old City of Brooklyn from the late Town of Flatbush, easterly by Washington

avenue and southerly and westerly by Flatbush avenue," as an addition to the land immediately adjacent and which is now maintained as a botanic garden and arboretum under the original agreement between the said City and the said Institute dated December 28, 1909, and

Recommendation for Addition of New Land. Boundaries thereof

WHEREAS, The said Board of Commissioners of Public Parks of the City of New York, on the 2d day of April, in the year 1914, passed the following resolution:

"*Resolved*, That, pursuant to chapter 178 of the Laws of 1911, and in consideration of the existing agreement between The City of New York and the Brooklyn Institute of Arts and Sciences for the establishment and maintenance of a botanic garden and arboretum on park lands in the Borough of Brooklyn, the Board of Commissioners of Public Parks of The City of New York hereby recommends to the Board of Estimate and Apportionment of the said City that the park lands bounded as follows: Beginning on the easterly side of Flatbush avenue at a point where the line formerly dividing the old City of Brooklyn from the late town of Flatbush intersects the said easterly side of Flatbush avenue and running in a northeasterly direction along the line formerly dividing the old City of Brooklyn from the late Town of Flatbush 746 feet 4 inches, more or less, to the westerly side of Washington avenue; thence in a southerly direction along the westerly side of Washington avenue 569 feet 11¾ inches, more or less, to the northwesterly side of the Brighton Beach railway lands; thence in a southwesterly direction along the northwesterly side of the Brighton Beach railway lands 545 feet 3⅜ inches, more or less, to the northerly line of Malbone street; thence westerly along the northerly side of Malbone street for a distance of 110 feet, more or less, to the easterly side of Flatbush avenue; thence in a northwesterly direction along the easterly side of Flatbush avenue 486 feet 1 inch, more or less, to the point of beginning, be added to the existing botanic garden and arboretum established under chapter 618 of the Laws of 1906, as amended by chapter 178 of the Laws of 1911, and maintained under an agreement between the said City of New York and the said Brooklyn Institute of Arts and Sciences, under the date of December 28, 1909, as

amended by an agreement between the said City and the said Institute under date of September 9, 1912, this said area hereinbefore described and bounded, to be maintained and administered as a part of the said Brooklyn Botanic Garden and Arboretum under the same terms and conditions as now exist and are in force for the maintenance and administration of the said existing Brooklyn Botanic Garden and Arboretum, the said same terms and conditions as to cancellation and annulment by the party of the first part to apply to this additional tract of land described in this resolution precisely as the terms and conditions of cancellation and annulment apply to the lands in the original botanic garden established in pursuance of the agreement entered into between The City of New York, party of the first part, and the said Brooklyn Institute of Arts and Sciences, party of the second part, dated the 28th of December, 1909; and subject to the following additional conditions, namely:

Provision for Possible Future Roadway

1. "That the Board of Estimate and Apportionment of The City of New York, on the recommendation of the Board of Commissioners of Public Parks of said City, reserves the right to withdraw from the lands hereinbefore described in this resolution, a strip of land across the southerly part of said lands from Washington avenue toward the Willink Entrance of Prospect Park for the construction by the Department of Parks of a roadway thereon, the boundaries of said strip of land and the location of said roadway to be determined by said Board of Estimate and Apportionment on the recommendation of the said Board of Commissioners of Public Parks; and in laying out, grading and planting lands as hereinbefore described and bounded, due account shall be taken of the possible need of such roadway in the future."

Requirements Concerning Pathway for Pedestrians

2. "The plans for the development and the use of these additional lands shall include a pathway for pedestrians running across the lands from Washington avenue to a point on Flatbush avenue near the Willink Entrance to Prospect Part and such pathway shall be kept open at such hours and times as shall be

designated by the Park Commissioner of the Borough of Brooklyn, or by his successor or successors."

Agreement to Second Amendment

NOW, THEREFORE, in consideration of the actions already taken under chapter 618 of the Laws of 1906, and chapter 178 of the Laws of 1911, and in consideration of the mutual agreements herein contained, it is agreed by and between the said parties that the agreement between the said City of New York and the said Brooklyn Institute of Arts and Sciences, entered into on December 28, 1909, and amended by an agreement entered into on September 9, 1912, be hereby further amended as follows:

Second Amendment. Grant of New Land

That the party of the first part has granted and demised, and doth by these presents grant, demise and let unto the said party of the second part, the parcel of park lands as hereinbefore described and bounded in the resolution of said Board of Commissioners of Public Parks to be added to the lands of the Brooklyn Botanic Garden and Arboretum leased to the Brooklyn Institute of Arts and Sciences on December 28, 1909, and the additional lands leased to the said Institute on September 9, 1912, the said Institute, party of the second part, to have and to hold the same so long as the said party of the second part shall continue to carry out the objects and purposes defined in its Charter or in the amendments of said Charter except as herein or as in the aforesaid agreement of December 28, 1909, and the amendment thereto of September 9, 1912, otherwise provided, and shall maintain and administer this said parcel of land hereinbefore bounded and described for the purposes of a Botanic Garden and Arboretum as provided in chapter 178 of the Laws of 1911; and shall faithfully keep, perform and observe the covenants and conditions herein contained on its part to be kept, performed and observed until said lands shall be surrendered by the said party of the second part or its surrender is required by the party of the first part as provided in the original agreement dated December 28, 1909, in the amendment to the agreement dated September 9, 1912, and as further provided in this agreement; and the said parcel of land shall be used and held by the party

of the second part under the same terms and conditions in all respects as the lands leased by the party of the first part to the said party of the second part on December 28, 1909, and as in the amendment dated September 9, 1912, with the following exceptions and conditions:

Right Reserved to Withdraw Strip for Roadway

1. "That the Board of Estimate and Apportionment of The City of New York, on the recommendation of the Board of Commissioners of Public Parks of said City, reserves the right to withdraw from the lands hereinbefore described in this resolution, a strip of land across the southerly part of said lands from Washington avenue towards the Willink Entrance of Prospect Park for the construction by the Department of Parks, of a roadway thereon, the boundaries of said strip of land and the location of said roadway to be determined by said Board of Estimate and Apportionment on the recommendation of the said Board of Commissioners of Public Parks; and in laying out, grading and planting lands as hereinbefore described and bounded, due account shall be taken of the possible need of such roadway in the future."

Construction of Pathway Specified

2. "The plans for the development and the use of these additional lands shall include a pathway for pedestrians running across the lands from Washington avenue to a point on Flatbush avenue near the Willink Entrance to Prospect Park, and such pathway shall be kept open at such hours and times as shall be designated by the Park Commissioner of the Borough of Brooklyn, or by his successor or successors."

Funds for Permanent Improvements and Annual Maintenance to be Provided by the City

And the party of the first part herein agrees to provide such sum or sums of money as the Board of Estimate and Apportionment may deem necessary to cover the cost of necessary grading, soil additions and other permanent improvements, and also to cover the cost of the annual maintenance of the said lands in the same manner that it provides for other permanent improvements and for maintenance in the Botanic Garden and Arboretum here-

tofore established through the said agreement, dated December 28, 1909, and the amendment to said agreement, dated September 9, 1912, and in pursuance of the authority granted by said chapter 178 of the Laws of 1911.

Terms of Cancellation and Annulment

And it is hereby expressly agreed that this contract may be cancelled and annulled at any time by the party of the first part, providing the Board of Estimate and Apportionment of the party of the first part, its successor or successors, after notice in writing to the party of the second part, served by mail or otherwise, notifying the party of the second part that some action is to be taken in reference to this agreement, by a vote of three-fourths of all its members, by motion or resolution, decide that it is for the best interests of the party of the first part that said contract be cancelled or annulled. And it is further agreed that upon said Board of Estimate and Apportionment aforesaid directing the cancellation or annulment of said contract, that the party of the first part shall serve upon the party of the second part, or its successor or successors, or any officer thereof, a notice in writing notifying the said party of the second part of the action of the said Board of Estimate and Apportionment, and the said party of the second part shall thereafter, and before the expiration of six months after the date of the service of said notice in writing, as aforesaid, notifying the party of the second part of the cancellation or annulment of the contract by the party of the first part, quit or surrender the said premises and remove all of its property therefrom except plants, trees and shrubs set in the soil and after such notice said party of the second part shall and will at or before the expiration of six months, quietly and absolutely yield up and surrender to the party of the first part, its successor or successors, all and singular the aforesaid demised premises, and upon the failure of the party of the second part to remove from said premises all its property and surrender and quit said premises as aforesaid, within six months after the service of notice as aforesaid, the said party of the first part shall have the right to enter in and upon said premises and take possession of same, together with all property of every kind, nature and description, remaining thereon.

Agreement to Modify or Annul

And it is further understood and agreed by and between the parties hereto that this agreement may be wholly cancelled or annulled, or from time to time be modified as may be mutually agreed in writing between said parties, or their successor or successors, anything herein contained to the contrary in anywise notwithstanding.

In witness whereof the party of the first part has caused this agreement to be executed by its Mayor, pursuant to a resolution of the Board of Estimate and Apportionment adopted at a meeting held on the 12th day of June in the year of our Lord nineteen hundred and fourteen, and the said party of the second part has caused the same to be executed by its President and Treasurer, and its official seal affixed thereto, pursuant to a resolution of the Board of Trustees of the Brooklyn Institute of Arts and Sciences adopted at a meeting held on the 12th day of June, in the year of our Lord nineteen hundred and fourteen.

CITY OF NEW YORK.
(Signed) GEORGE MCANENY,
Acting Mayor.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES
(Signed) A. AUGUSTUS HEALEY,
President.
(Signed) DANIEL V. B. HEGEMAN,
Treasurer.

Approved as to form
(Signed) C. V. OLENDORF,
Acting Corporation Counsel.

ACQUISITION AND COST OF THE LAND COMPRISING THE BROOKLYN BOTANIC GARDEN

The City of New York Record of Real Estate, as published in the *City Record* for May 6, 1913, gives on page 4159 a partial list of the property now comprised in the Brooklyn Botanic Garden. The boundaries are given as Eastern Parkway, Flatbush and Washington Avenues, and Malbone Street (now Empire Boulevard), and the area as 39.9 acres. This is the area of the

original land set aside for Botanic Garden purposes on December 28, 1909, and therefore does not include the North and South Additions. The property is designated as used for the Brooklyn Botanic Garden, with a footnote stating that the area was formerly known as Institute Park. According to the acreage given, the site of the Brooklyn Museum is also not included.

The property consists of four parcels of land acquired as follows:

1. April 25, 1904, by condemnation, at a cost of	$358,047.64
2. December 22, 1905, from Lucy A. B. Sterling, at a cost of	12,000.00
3. December 26, 1905, from Margaret Kelly, at a cost of	17,000.00
4. November 25, 1907, by condemnation, at a cost of	123,115.01
TOTAL	$510,162.65

The site of Mr. Prospect Reservoir was acquired by condemnation in 1857 at a cost of $95,500. This included the area of the "North Addition" of the Garden of about three acres—approximately one-third of the original reservoir site. The cost of the "North Addition," therefore, may be estimated as not in excess of one-third of $95,500, or about $31,833.

The "South Addition" comprises ten parcels as shown on Landmap 4 on file in the Department of Finance, Municipal Building, Manhattan. These were acquired by condemnation, the report being dated and filed June 8, 1905. Title vested April 25, 1904. The cost of these parcels is recorded as follows:

Parcel 1. Mary B. Cusick, as executrix	$ 76,000
Interest	4,636
2. Charlotte C. Van Brunt	600
Interest	36
3. Stephen M. Hoye	2,000
Interest	122
4. Ellen McLoughlin & Wm. Courtney, Administrators	136,000
4*a*. " " " " " "	Incl. in parcel 4
5. " " " " " " " " " "	4
6, 7, 7*a*, 8, 9. Serena Robbins, et. al.	75,700
TOTAL	$295,094

Lot 9, the eleventh parcel, refers to a very small triangular area at the north end of the site of the Fire Alarm Telegraph Bureau, separated from the Garden site on the south-east by the

Brighton Line railway cut. The cost of this area is included in the last item above and in the total.

The total cost to the City, therefore, of all the land now comprised within the Botanic Garden was $837,089.65, as follows:

1. The original 39.9 acres	$510,162.65
2. The North Addition (approximate)	31,833.00
3. The South Addition	295,094.00
TOTAL	$837,089.65

ACQUISITION BY THE CITY OF NEW YORK AND BOUNDARIES OF THE LAND COMPRISING THE "SOUTH ADDITION" OF THE BROOKLYN BOTANIC GARDEN

RESOLUTION OF THE BOARD OF ESTIMATE AND APPORTIONMENT PASSED DECEMBER 12, 1902, IN THE MATTER OF ACQUIRING FOR THE CITY OF NEW YORK TITLE TO THE LAND COMPRISING THE SOUTH ADDITION TO THE BROOKLYN BOTANIC GARDEN

(*From the Minutes of the Meeting of December 12, 1902*)

Whereas, on July 22, 1902, the Board of Aldermen of the City of New York, by a two-thirds vote of all the members elected voting in favor thereof, passed the following resolutions:

Be it ordained by the Board of Aldermen of the City of New York as follows:—

"That, in pursuance of the provisions of section 442 of the Greater New York Charter, the following resolution of the Board of Estimate and Apportionment, adopted by that Board on the 20 day of June, 1902, be and the same hereby is approved, viz:

"Resolved, That the Board of Estimate and Apportionment of the City of New York, in pursuance of the provisions of section 442 of the Greater New York Charter, deeming it for the public interest to alter the map or plan of the City of New York by locating and laying out an addition to Prospect Park, and closing and discontinuing certain streets for the construction of an

approach to the Willink entrance to Prospect Park, in the Twenty-ninth Ward, Borough of Brooklyn, City of New York, does hereby favor and approve of the same so as to locate and lay out the said approach as follows:

"1. Locating and laying out an addition to Prospect Park.

"Beginning at the intersection of Flatbush Avenue and Malbone Street, as the same are laid down on the map of the City:

"1. Thence northerly along the eastern line of Flatbush Avenue for 477.28 feet, more or less, to the southern line of East Side Lands;

"2. Thence easterly along the southeasterly line of East Side Lands for 763.55 feet, more or less, to the western line of Washington Avenue;

"3. Thence southerly for 1,050.79 feet, more or less, along the western line of Washington Avenue to the northern line of Malbone Street.

"4. Thence westerly along the northern line of Malbone Street for 341.82 feet to the point of beginning.

"11. Closing and discontinuing of Washington Place and a street north of Washington Place, as the same are laid down, between Washington Avenue and Flatbush Avenue."

Resolved that the Board of Estimate and Apportionment, in pursuance of section 970 of Chapter 455 of the Laws of 1901, deem it for the public interest that title to the lands and premises required for the locating and laying out of an addition to Prospect Park, in the Borough of Brooklyn, in the City of New York, should be acquired by the City of New York, the said land and premises being bounded and described as follows:

"Parcel A

"Beginning at the intersection of the easterly line of Flatbush Avenue with the northerly line of Malbone Street, as the same are laid down on the map of the City, running thence northerly along the easterly line of Flatbush Avenue four hundred seventy-seven and twenty-eight one hundredths (477.28) feet, more or less, to the line of the east side lands; thence easterly along the east side lands seven hundred sixty-three and fifty-five one hundredths (763.55) feet, more or less, to the westerly line of Washington Avenue, thence southerly along the westerly line of

Washington Avenue five hundred sixty-nine and thirty-six one hundredths (569.36) feet, more or less, to the northwesterly line of the Brooklyn and Brighton Beach Railroad, thence southerly along the northwesterly line of the Brooklyn and Brighton Beach Railroad five hundred forty-five and thirty-six one hundredths (545.36) feet, more or less, to the northerly line of Malbone Street; and thence westerly along the northerly line of Malbone Street one hundred and ten (110) feet, more or less, to the point of beginning.

" Parcel B

"Beginning at the intersection of the northerly line of Malbone Street with the westerly line of Washington Avenue, as the same are laid down on the map of the City; running thence westerly along the northerly line of Malbone Street one hundred sixty-three and eighty-three one hundredths (163.83) feet, more or less to the southeasterly line of the Brooklyn and Brighton Beach Railroad; thence northerly along the southeasterly line of the Brooklyn and Brighton Beach Railroad three hundred eighty-one and sixteen one hundredths (381.16) feet, more or less, to the westerly line of Washington Avenue; and thence southerly along the westerly line of Washington Avenue three hundred ten and fifty-nine one hundredths (310.59) feet, more or less, to the point of beginning."

Resolved, That the Board of Estimate and Apportionment hereby requests the Corporation Counsel to take the necessary proceedings in the name of the City of New York to acquire title, whenever the same has not been heretofore acquired, to the lands, tenements and hereditaments, for the purpose of locating and laying out said addition to Prospect Park.

Resolved, That the Board of Estimate and Apportionment, in pursuance of the provisions of section 980 of chapter 466 of the laws of 1901, hereby directs that the entire cost of the above named proceeding be borne and paid by the City of New York.

A true copy of a resolution adopted by the Board of Estimate and Apportionment, December 12, 1902.

(Signed) JOSEPH HAAG,
Secretary.

APPRAISAL OF THE LAND COMPRISING THE BROOKLYN BOTANIC GARDEN

In 1913 the land comprising the Brooklyn Botanic Garden was appraised by the City at $2,400,000, of which $2,200,000 referred to the original area assigned by the Department of Parks for Botanic Garden Purposes on December 28, 1909; and $200,000 to what is now known as the "North Addition," between Mt. Prospect Reservoir and the Brooklyn Museum building (fronting on Eastern Parkway) and a strip 20 feet wide along the southern boundary of the reservoir property, assigned to the Brooklyn Institute of Arts and Sciences for Botanic Garden purposes on September 9, 1912. The "South Addition" was not then a part of the Garden.

These figures do not include the site of the Brooklyn Museum, nor the improvements to the property since it was acquired.

According to a report from the City of New York, Department of Taxes and Assessments, Borough of Brooklyn, received by the Botanic Garden February 27, 1926, the appraisal of the property for the year 1926, including the "South Addition," was as follows:

Land	$6,500,000
Buildings	500,000
TOTAL	$7,000,000

The boundaries of the South Addition are described in the amended *Agreement* of August 17, 1914 (pp. 291; also 299–300, *infra*).

REORGANIZATION OF THE BROOKLYN INSTITUTE

In January, 1915, the Board of Trustees undertook the work of reorganizing The Brooklyn Institute of Arts and Sciences. This involved the abolition of the office of Director of the Institute, and the formal recognition of three coordinate departments, as referred to below, with three directors, independent each of the other, and each reporting directly to a special Governing Committee of the Trustees.

The new constitution, embodying these features, was adopted on January 14, 1915. The Articles and Sections relating especially to the Botanic Garden are as follows:

"ARTICLE I

"*Objects*

"*Section 1.* The purposes of said corporation shall be the establishment and maintenance of Museums and Libraries of Arts and Sciences, the encouragement of the study of the Arts and Sciences and their application to the practical wants of man, the advancement of knowledge in science and art, and in general provision for popular instruction and enjoyment through its collections, libraries and lectures.

"The museums and libraries of said Corporation shall be open and free to the public and private schools of the City of New York at all reasonable times and open to the public on such terms of admission as shall be approved by the Mayor of the City and the Park Commissioner of the Borough of Brooklyn.

"ARTICLE II

"*Membership*

"*Section 1.* The membership of the Brooklyn Institute of Arts and Sciences shall comprise Benefactors, Patrons, Donors, Permanent Members, Life Members, Honorary Members, Fellows, Corresponding Members, Sustaining Members, Associate Members, Museum Members, and Botanic Garden Members.

"*Section 2.* The contribution or devise, according to the amount donated by him to the funds of the Institute in cash or securities, collections in art or science, or other property which shall be estimated by the Board of Trustees to be fully worth the sums named below, shall qualify the donor to be elected to one of the following classes of membership, viz.:

"BENEFACTOR, upon payment of $100,000 or over.

"PATRON, upon payment of $25,000, or over up to $100,000.

"DONOR, upon payment of $10,000, or over up to $25,000.

"PERMANENT MEMBER upon payment of $2,500. Permanent members shall be entitled to transfer their membership by will or other legal process.

"LIFE MEMBER, upon payment of $500.

"Any person being elected to one of the above classes of membership may, if he desire, have the option of designating a particular Department of the Institute under which he shall be enrolled.

"*Section 6.* SUSTAINING MEMBERS, who shall be entitled to all the privileges of Associate Members, Museum Members, and Botanic Garden Members, may also be elected by the Board of Trustees. There shall be no registration fee for Sustaining Members. Their Annual Dues shall be Twenty-five Dollars ($25) which shall be apportioned, as directed by the Trustees, among the three Departments of the Institute.

"*Section 9.* BOTANIC GARDEN MEMBERS may be elected by the Trustees on the recommendation of the Membership Committee. Their annual dues shall be Ten Dollars ($10) payable in advance, to be used exclusively for Botanic Garden purposes. They shall be entitled to admission to all receptions and lectures given at the Botanic Garden and to exhibits and openings preceding the admission of the public, and to all regular publications of the Botanic Garden.

"*Section 10.* The Benefactors, Patrons, Donors, Permanent Members and Life Members of the Institute shall also be known as the CORPORATE MEMBERS OF THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, and shall in addition have all of the privileges of Sustaining Members. Each Corporate Member shall be entitled to vote in the election of Trustees of the Institute, and shall be eligible to election as a member of the Board of Trustees. The corporate powers of the Institute shall be vested in the Trustees. Fifteen Corporate Members shall constitute a quorum for the election of Trustees and transaction of other business.

"ARTICLE III

"*Management*

"*Section 8.* The work of the Institute shall be divided into three general Departments, namely: Department of Education, the Museums, and the Botanic Garden. Each of these Departments shall be in charge of a Director appointed by the Board of Trustees and of a Governing Committee of not less than five,

who with their Chairman shall be appointed from the Board of Trustees by the President. Each of said Directors shall have general charge and supervision of his Department, subject to the direction of the Governing Committee of that Department and of the Board of Trustees, and shall report to the Board and the Governing Committee of his Department, as often as required, concerning the work and needs of such Department.

"ARTICLE IV

"*Committees of the Corporation*

"*Section 1.* There shall be the following standing committees of the Board:

"1. GENERAL COMMITTEE.

"2. GOVERNING COMMITTEE of the Department of Education.

"3. GOVERNING COMMITTEE of the Museums.

"4. GOVERNING COMMITTEE of the Botanic Garden.

"5. FINANCE COMMITTEE.

"6. MEMBERSHIP COMMITTEE.

"*Section 2.* The General Committee shall consist of the officers of the Board and the Chairmen and one member, appointed by the President, of each Governing Committee, and the Chairman of the Finance and Membership Committees. The President shall be Chairman and the Secretary shall be Secretary of the Committee. Said Committee shall, under the direction of the Board of Trustees, have the power, not specially delegated to the Governing Committees, to act upon all matters relating to the interests and management of the Corporation and upon such matters as may be referred to it by the Board or by any Committee. During the summer recess of the Board, the General Committee shall have authority, in such manner as the Board shall determine, to act on behalf of the Board of Trustees.

"*Section 5.* The Governing Committee of the Botanic Garden shall, under the direction of the Board of Trustees, have charge of the Botanic Garden, with general supervision of the grounds and buildings pertaining thereto. They shall have power to make all necessary repairs, and to regulate the use of the grounds, buildings and collections and in general have charge of all work relating to the Botanic Garden.

"*Section 6.* Each Governing Committee shall elect its own Secretary and shall report to the Board of Trustees at its regular meetings and at such other times as it shall be required. Each Governing Committee shall have the power to appoint such subcommittees as it may deem necessary, prescribing their duties. The chairmen of such subcommittees must be members of the Governing Committee.

"Each Governing Committee, subject to the direction of the Board of Trustees, shall make all contracts on behalf of the Board, relating to the work of its Department, shall audit all bills against the Institute relating thereto, and in general execute the will of the Board in all matters pertaining to the work of its Department not otherwise especially delegated.

"*Section 7.* The Finance Committee shall, under the direction of the Board of Trustees, have charge of the collection, increase and investment of the endowment and permanent funds of the Institute, and shall have general charge of the financial interest of the corporation. It may also advise the Treasurer as to any necessary regulations for the work of the Treasurer's office, or the deposit or control of the current funds.

"*Section 8.* The Membership Committee shall, under the direction of the Board of Trustees, have charge of the admission of members and the general increase of the membership of the Institute in its various Departments."

AGREEMENT BETWEEN THE BOTANICAL SOCIETY OF AMERICA AND THE BROOKLYN BOTANIC GARDEN CONCERNING THE PUBLICATION OF A JOURNAL OF BOTANY

1. In order to help finance the launching of a new journal of botany, the Brooklyn Botanic Garden guarantees to become responsible to the extent of not more than one hundred dollars ($100) an issue, for ten issues a year, and suggests that for the present, ten monthly issues (omitting August and September) constitute one volume.

2. The Botanical Society of America, as soon as the publication of the new journal is decided upon, agrees to advance a sum of not less than three hundred dollars ($300), to meet the necessary

initial expense, and to contribute toward the maintenance of the journal, annually thereafter, and until notice to the contrary is served one year in advance, or until mutual agreement to the contrary, the income from its accumulated funds toward the cost of publishing the journal; and the Botanical Society of America further agrees to assign annually a portion of the annual membership dues of each member, to an amount of not less than three dollars per member, as a subscription for the proposed journal, to be paid by the treasurer of the Botanical Society to the business manager of the journal.

3. It is further mutually agreed as follows:

(*a*) That, during the tenure of this agreement, the business manager of the journal shall be a member of the scientific staff of the Brooklyn Botanic Garden, that the undistributed copies of each number, and all the exchanges shall be deposited in the library of the Garden; and that the exchanges shall become the permanent property of the Garden. If, and whenever, at any time, the gross income of the journal, from all sources (including subscriptions, advertisements, the sale of back numbers and sets, and any subsidies or endowments), shall exceed the necessary expenses of publication, postage, stationery, etc., the surplus, either as principal or as interest on the same, shall be applied to improving the journal, either by increasing the number of pages, or the number or quality of the illustrations, or the quality of the paper, one or all, or in any other way, according as the editors and management may jointly agree; and the payment of an honorarium to contributors should be kept in mind as an end to be attained at the earliest possible date consistent with maintaining the magazine at a reasonable degree of excellence.

(*b*) That underneath the official name of the journal on the front page of the cover, and on the editorial or business page, there be printed the statement: "Official Publication of the Botanical Society of America"; and that the statement of publication, wherever printed, shall read: "Published in cooperation with the Botanical Society of America, by the Brooklyn Botanic Garden, at (address of printers)."

(*c*) That the editorial board, which shall control the general editorial policy, shall (with the exception of one member to be

appointed by the Brooklyn Botanic Garden, in addition to the business manager) be elected by the Botanical Society of America under such terms and conditions, and at such periods as said Society may formally determine.

(*d*) That the agreement, to be entered into as above, shall remain in force for not less than three years; and that it may be terminated by either party only after written notice of intention to terminate shall have been given to the proper official, at least one year in advance.

(*e*) That in case, and when, the agreement shall terminate, the Botanical Society of America shall have possession of the reserved copies of the journal and shall have the right to the name of the journal; but the Brooklyn Botanic Garden shall retain ownership of the exchanges already received, and of such numbers of incomplete volumes of exchanges as are necessary to complete the current volumes.

For Botanical Society of America:

(Signed) F. C. NEWCOMBE,
GEORGE T. MOORE,
DUNCAN S. JOHNSON,
L. R. JONES,
R. A. HARPER,
Committee on New Journal.

For Brooklyn Botanic Garden:

(Signed) C. STUART GAGER,
Director of the Botanic Garden.

AGREEMENT BETWEEN THE ECOLOGICAL SOCIETY OF AMERICA AND THE BROOKLYN BOTANIC GARDEN CONCERNING THE PUBLICATION OF THE JOURNAL "ECOLOGY"

WHEREAS, the Ecological Society of America, recognizing the lack of adequate provision in the United States for publishing the results of research, and for diffusing information, in the general subject of ecology, desires to establish and publish a new journal for this purpose, and

WHEREAS, the Brooklyn Botanic Garden, organized for the advancement and diffusion of a knowledge and love of plants, desires to cooperate with the Ecological Society of America in the publication of the proposed journal, it is, therefore, mutually agreed between the Ecological Society and the Botanic Garden as follows:

1. The monthly journal now known as the *Plant World* shall be acquired and taken over by the Ecological Society according to such terms as it may agree upon with the Plant World Association.

2. The Brooklyn Botanic Garden shall assume no obligations and shall incur no responsibility as between the Plant World Association and the Ecological Society, and the Ecological Society of America hereby absolves the Brooklyn Botanic Garden from all such responsibility and obligations.

3. The name "*Plant World*" shall be discontinued as the major title of the new journal.

4. The new journal shall be called *Ecology*.

5. Underneath the name Ecology, on the front page of the cover of each issue and elsewhere in the publication as may be subsequently agreed upon, shall be printed the following statements, or statements substantially equivalent thereto.

Continuing the Plant World
Official Organ of the
Ecological Society of America

6. At or near the bottom of the front page of the cover of the journal, and elsewhere as may subsequently be agreed upon, shall appear the following statement of publication:

Published
In Cooperation with the Ecological Society of America
by the
Brooklyn Botanic Garden
at
(Address of the Printers)

7. The Business Manager of the journal shall be the Brooklyn Botanic Garden, or such officer or member of staff as the Director of the Garden may from time to time designate.

8. Advertisements may be carried on the third and fourth pages of the cover, and on inside pages additional to those containing reading matter. The advertisements shall be of a character acceptable to both the Ecological Society and the Botanic Garden.

9. The second page of the cover shall be reserved for editorial and business announcements of the journal.

10. No charge is to be made to the Ecological Society for the storage of undistributed copies of the journal at the Brooklyn Botanic Garden, but if it becomes necessary to pay rental or insurance for storage accommodations outside the Botanic Garden Buildings such rental shall become a charge against the account of the journal.

11. All publications received in exchange for the journal shall be deposited in the library of the Brooklyn Botanic Garden, and shall become the permanent property of the Garden, and shall become subject to the regulations governing the administration of the library.

12. If, and whenever, at any time, the gross income of the journal, from all sources (including subscriptions, advertisements, the sale of back numbers and sets, and any subsidies or endowments), shall exceed the necessary expenses of publication, postage, stationery, office assistance, etc., the surplus, either as principal or as interest on the same, shall be applied to improving the journal, either by increasing the number of pages, or the number or quality of the illustrations, or the quality of the paper, one or all, or in any other way, according as the editors and management may jointly agree; and the payment of an honorarium to contributors should be kept in mind as an end to be attained at the earliest possible date consistent with maintaining the magazine at a reasonable degree of excellence.

13. That the editorial board, which shall control the general editorial policy, shall (with the exception of one member who may be appointed by the Brooklyn Botanic Garden, at its option, in addition to the business manager) be elected or appointed by the Ecological Society of America under such terms and conditions, and at such periods as said Society may formally determine.

14. The frequency of publication, and the number of pages per issue, shall be as mutually agreed upon from time to time by the editorial board and the business manager.

15. The Ecological Society of America agrees to advance a sum of not less than one hundred dollars ($100) to meet necessary initial expenses, and to assign annually a portion of the annual membership dues of each member, to an amount of not less than two dollars per member, as a subscription to the journal to be paid by the treasurer of the Ecological Society to the business manager of the journal. These payments are to be made from time to time with reasonable promptness as the membership dues are received by the treasurer of the Society. Payment is to be made for members in arrears for dues unless and until the business manager is notified by the treasurer of the Society to remove from the mailing list of the journal the name or names of those in arrears for dues.

16. All members of the Ecological Society in good standing shall receive one copy of each issue of the journal without any payment in addition to the membership dues in the Society.

17. The fiscal year of the journal shall end on November 30; and the business manager shall render an annual financial statement to the Ecological Society of America at the time and place of its annual meeting.

18. The Brooklyn Botanic Garden agrees to become responsible for any annual deficit not to exceed Three Hundred Dollars ($300) a year. In consideration of this provision the choice of printer and the drawing of all contracts for printing and illustrating shall rest with the business management, and no expenses shall be incurred in the name of or on behalf of the journal except by or with the approval of the business manager.

19. This agreement shall remain in force for not less than three years from date (January 1, 1920), and may be terminated by either party only after written notice of intention to terminate shall have been given to the proper official at least one year in advance.

20. In case, and when, this agreement shall terminate, the Ecological Society of America shall have possession of all over copies of the journal and of the mailing lists, and shall have the right to the name of the journal; but the Brooklyn Botanic Garden shall retain ownership of the exchanges already received, and of such numbers of incomplete volumes of exchanges as are necessary to complete current volumes.

For the Ecological Society of America:

(Signed) BARRINGTON MOORE,
(Signed) CHAS. C. ADAMS.

For the Brooklyn Botanic Garden:

(Signed) C. STUART GAGER.

BROOKLYN, NEW YORK,
January 1, 1920.

AGREEMENT BETWEEN THE EDITORIAL BOARD OF GENETICS AND THE BROOKLYN BOTANIC GARDEN CONCERNING THE PUBLICATION OF THE JOURNAL "GENETICS"

WHEREAS the Editorial Board of *Genetics* desires the Brooklyn Botanic Garden to become the publisher of that journal; and

WHEREAS the Brooklyn Botanic Garden desires so to cooperate with the Editorial Board of *Genetics*, it is therefore mutually agreed as follows:

1. For the present, and until further agreement otherwise, the period of issue shall be bi-monthly and the total number of pages per volume of six numbers shall not exceed 600, more or less.

2. The Editorial Board agrees to assume all responsibility for securing and editing copy, for forwarding same regularly and promptly to the printers, for the reading and prompt return of proof, and for all other editorial matters.

3. At or near the bottom of the front page of the cover of the journal, and elsewhere, as may subsequently be agreed upon, shall appear the following statement of publication:

Published by the
Brooklyn Botanic Garden
at
(Address of the printers)

4. The Business Manager of the Journal shall be the Brooklyn Botanic Garden, or such officer or member of the Botanic Garden staff as the Director may from time to time designate.

5. Advertisements may be carried on special pages inserted after the scientific articles, and not elsewhere except by mutual agreement. All the cover pages shall, for the present and until

mutually agreed otherwise, be reserved for announcements relating to *Genetics*. The advertisements shall be of a character acceptable to both the Editorial Board and the Botanic Garden.

6. No charge is to be made to the Editorial Board for the storage of undistributed copies of the journal at the Brooklyn Botanic Garden, but if it becomes necessary to pay rental or insurance for storage accommodations outside the Botanic Garden buildings, such rental or insurance shall become a charge against the account of the journal.

7. All publications received in exchange for the journal, except editorial exchanges, shall be deposited in the library of the Brooklyn Botanic Garden, and shall become the permanent property of the Garden, and shall become subject to the regulations governing the administration of the library.

8. If, and whenever, at any time, the gross income of the journal, from all sources (including subscriptions, advertisements, the sale of back numbers and sets, and any subsidies or endowments), shall exceed the necessary expenses of publication, postage, stationery, business office assistance, etc., the surplus, either as principal or as interest on the same, shall be applied to improving the journal, either by increasing the number of pages, or the number or quality of the illustrations, or the quality of the paper, one or all, or in any other way, according as the editors and managements may jointly agree.

9. Three free copies of *Genetics* shall be forwarded to the Managing Editor, but no other free copies shall be issued, except on the basis of exchange, as provided in paragraph seven above.

10. The fiscal year of the journal shall end on November 30, and the Business Manager shall render an annual financial report to the Managing Editor.

11. The Brooklyn Botanic Garden agrees to become responsible for any annual deficit not to exceed Three Hundred Dollars ($300) a year. In consideration of this provision, the choice of printer, and the drawing of all contracts for printing and illustrating shall rest with the business management, and the Business Manager or publisher shall not be liable for any expenses incurred in the name of, nor on behalf of, the journal except by, or with the approval of, the Business Manager.

12. It is understood that no change shall be made in the physical qualities, stock, make-up, or quality of illustrations without mutual agreement.

No copyright shall be placed on the title "Genetics," nor on any of the contents of any issue, except by mutual agreement.

13. It is expressly understood and agreed that, in entering into this agreement, the Brooklyn Botanic Garden does not assume any of the financial obligations incurred by the Editorial Board, nor by the former publishers or printers previous to the date when this agreement shall become effective, nor does the Botanic Garden become liable for any indebtedness to any former printer or publisher incurred by or in the name of the Editorial Board, or by any other party. The Editorial Board hereby absolves the Brooklyn Botanic Garden from all such indebtedness, and furthermore agrees to assume all responsibility relating to any infringement of copyright, and to indemnify the Brooklyn Botanic Garden against any claims or losses that may arise therefrom.

14. In case, and when, this agreement shall terminate the Brooklyn Botanic Garden shall have possession of all over copies of *Genetics*, and shall retain ownership of the exchanges already received, and of such numbers of incomplete volumes of exchanges as are necessary to complete current volumes; but the Editorial Board shall have possession of the mailing lists, and shall have the right to the name of the journal.

15. This agreement shall remain in force for not less than three years from January 1, 1922, and may be terminated by either party only after written notice of intention to terminate shall have been given to the proper official at least one year in advance.

For the Editorial Board:

(Signed) GEORGE H. SHULL,
Secretary and Managing Editor.

For the Brooklyn Botanic Garden:

(Signed) C. STUART GAGER,
Director.

BROOKLYN, N. Y.,
December 31, 1921.

AGREEMENT BETWEEN NEW YORK UNIVERSITY AND THE BROOKLYN BOTANIC GARDEN

For the purpose of encouraging botanical investigations, and for their mutual advantage in this connection, the New York University, party of the first part, and the Brooklyn Botanic Garden, party of the second part, hereby agree as follows:

FIRST: That such members of the scientific staff of the Botanic Garden as it may designate with the concurrence of the University authorities, shall be made officers of instruction in the Graduate School of the University, and attached to the department of Biology in that School, with the title of "Lecturer."

SECOND: That courses of graduate rank offered by the Garden, when approved by the Faculty of the Graduate School of the University, shall be listed as courses in the Graduate School, with all of the privileges pertaining to the other courses offered in the Graduate School.

THIRD: Properly qualified students pursuing these courses shall be eligible as candidates for advanced degrees given by New York University, under the rules of the Graduate School relating to such degrees.

FOURTH: Except in those cases where the tuition at the Garden is fully met by the income from any scholarships, fellowships, or assistantships that may be established, New York University shall pay to the Brooklyn Botanic Garden for each course taken by one of its graduate students registered at the Garden, a sum equal to the entire fee which it collects for such course.

FIFTH: Each registered student shall pay to the Botanic Garden whatever laboratory fee the Garden may establish for all students taking any given course.

SIXTH: The Brooklyn Botanic Garden on its part, agrees to extend to such registered students from the University the full privileges of its library, herbarium, laboratory equipment and collections of living plants, and such study material as may reasonably be required for the satisfactory prosecution of their investigations.

SEVENTH: It is further mutually agreed that any announcement concerning this agreement, to be published by either party, shall be submitted to the other party and receive its official approval before being published.

EIGHTH: It is understood and mutually agreed that this agreement does not prevent either party from entering into a similar cooperative agreement with any other institution.

NINTH: This agreement may be absolved by either party only after notice of intention to absolve has been given to the other one year in advance.

(Signed) ELMER E. BROWN,
Chancellor, New York University.
(Signed) C. STUART GAGER,
Director, Brooklyn Botanic Garden.

April 1, 1916.

PLAN OF COOPERATION BETWEEN LONG ISLAND UNIVERSITY AND BROOKLYN BOTANIC GARDEN

I. EXTENSION COURSES FOR CREDIT.

1. Courses leading to undergraduate credit.

   Courses given at the Botanic Garden, which conform to academic standards approved by Long Island University in regard to content and method of instruction, shall be accepted by Long Island University for undergraduate credit. These standards require the courses to be given in the form of lectures, quizzes or laboratory instruction, assigned reading, and examinations.

   The instructors giving these courses shall be trained in conformity with the usual academic standards.

2. Registration of students.

   Students registered in an accepted Botanic Garden course, who desire to obtain credit from the University, shall meet the admissions requirements of the University, register with the University Registrar, and pay a registration fee of $10 each semester.

3. Granting of degrees.

   Students referred to in paragraph 2 who have met the requirements of an accepted course may receive

undergraduate credit from the University. Students who have studied in other institutions of collegiate standing may apply for advanced standing in the University.

Upon completion of the requirements of Long Island University for graduation in the arts or in the sciences, the student may apply for the degree of Bachelor of Arts or Bachelor of Science.

II. Graduate Credit.

As the University has not as yet established a Graduate School, it cannot confer credits leading toward a graduate degree.

III. Other Privileges.

Long Island University agrees to place at the disposal of the Botanic Garden the services of the Professor of Botany in an advisory capacity. The Botanic Garden agrees to permit properly qualified students of Long Island University the use of its library and herbaria, under the regulations governing their general use.

IV. Catalogue Notices.

Notice of the cooperation of the Botanic Garden with the University shall appear in the official Prospectus of the Botanic Garden and in the official Catalogue of the University.

For Long Island University:
(Signed) George R. Hardie, *Dean.*

For Brooklyn Botanic Garden:
(Signed) C. Stuart Gager, *Director.*

Brooklyn, N. Y.,
January 26, 1931.

ARTICLES OF AGREEMENT BETWEEN THE AMERICAN IRIS SOCIETY AND THE BROOKLYN BOTANIC GARDEN

The American Iris Society, hereinafter called the Society, and The Brooklyn Botanic Garden, hereinafter called the Garden, hereby agree to cooperate for the purpose of establishing a collection of Japanese irises and for the study of their cultivation, nomenclature, classification, and comparative merit, and for such other matters as may be hereafter agreed upon.

This agreement is to extend over a period of five years, extending from 1920 to 1924 inclusive, and may be terminated upon one year's notice by either party or extended by mutual agreement.

The Garden agrees as follows:

1. To provide land within its own grounds, labor of planting, and proper care and maintenance.

2. That all records relating to the subjects of study, excluding notes of a strictly preliminary nature, shall be kept in duplicate and one copy supplied to the Society for use and preservation.

3. That any standards (of classification, methods of recording, etc.) which may be accepted by the Society shall be used when pertinent or applicable, and that nothing tending to establish a standard in respect to *Iris* shall be published without the previous approval and consent of the Society or its Board of Directors.

4. That data secured from this collection shall be open to the use of the Society and that any Bulletins thereon published by the Garden shall be furnished to the Society in number equal to twice the amount of the then membership.

5. That stock of irises furnished by the Society or stock resulting from its increase shall not be disposed of by sale or exchange except with the approval of the Board of Directors of the Society.

The Society agrees as follows:

1. To furnish without charge the necessary stock that can be secured through the contributions of its members or from interested growers. Three plants constitute a test; one or two may be provided.

2. To cooperate fully in the collecting of data.

3. That the Garden may be required to act contrary to this agreement, since it occupies City property and derives income from city funds.

It is mutually understood by both parties:

1. That either party may publish such data as has been gathered, but that incomplete data may not be released for publication except by special consent of both parties.

2. That at the close of this agreement or at any previous time agreed upon the stock or portions thereof shall be divided as follows; to the Garden three plants each of all distinct varieties; to the contributor, subject to his expressed wish, plants equal to his original contribution, if available; to the Garden and the Society, equal portions of all remaining stock.

3. That all claims to damages due to non-fulfillment of this agreement are waived.

4. That the essence of this agreement is the development, maintenance, and study of a beautiful, complete, and valuable collection of Japanese irises, and the utilization of it in such manner as to promote the aims and objects of the Society and the Garden jointly.

For the Society:
(Signed) JOHN C. WISTER,
President
(Signed) R. S. STURTEVANT,
Secretary, April 20, 1920

For the Botanic Garden:
(Signed) C. STUART GAGER,
Director
April 19, 1920

AGREEMENT BETWEEN THE BROOKLYN BOTANIC GARDEN AND THE AMERICAN FERN SOCIETY CONCERNING STORAGE OF BACK VOLUMES AND PARTS OF THE AMERICAN FERN JOURNAL AT THE BOTANIC GARDEN

WHEREAS, the American Fern Society, for the better safeguarding and handling of the back volumes and numbers of its official publication, the *American Fern Journal*, desires to secure storage accomodations at some scientific institution; and

WHEREAS, the Brooklyn Botanic Garden has, for several years, included studies in ferns among its research projects, by the

appointment of Dr. Ralph C. Benedict as Resident Investigator, and otherwise; and

WHEREAS, the Botanic Garden wishes to facilitate the publication of information concerning ferns; and

WHEREAS, Dr. Benedict is an Editor of the *American Fern Journal*, it is mutually agreed as follows:

1. The Brooklyn Botanic Garden will provide in its Laboratory Building and without charge to the American Fern Society, storage space for the back volumes and numbers that have accumulated to date, and for the over-copies of subsequent numbers as issued.

2. The Botanic Garden agrees to receive and fill orders for back numbers and volumes of the *Fern Journal*, and the American Fern Society agrees to reimburse the Garden for postage, services, and all other expenses in connection with receiving and filling orders.

3. The Botanic Garden is not to be put to any expense, either in the delivery of the journals to the Garden or subsequently in any transfer or removal of them from the Garden.

4. Properly authorized representatives of the American Fern Society are to have access to the stored journals as may be desired from time to time, in harmony with the regulations concerning hours and days of opening and closing of the Laboratory Building of the Garden, and access thereto and to its various rooms.

5. The Botanic Garden agrees to keep the journals stored in a suitable place, and to exercise every reasonable precaution for their proper and satisfactory preservation, but the American Fern Society specifically absolves the Brooklyn Botanic Garden, and any and all of its employees, from all responsibility for any injury or loss to the stored journals through fire, theft, water, or otherwise.

6. Either party to this Agreement will give the other party not less than six months notice of its desire and intention to terminate and cancel this Agreement.

7. The American Fern Society will remove all of its journals or other belongings from the Laboratory Building and property of the Brooklyn Botanic Garden within not less than six months after notice from the Botanic Garden of its desire to terminate and

cancel this Agreement; and the Botanic Garden will permit the removal of said journals and belongings within six months of notice from the American Fern Society of its desire to remove them and cancel this Agreement.

For the Brooklyn Botanic Garden:
(Signed) C. STUART GAGER,
Director.

For the American Fern Society:
(Signed) WILLIAM R. MAXON,
President.

BROOKLYN, N. Y.
January 15, 1927.

AGREEMENT BETWEEN BROOKLYN BOTANIC GARDEN AND THE AMERICAN FERN SOCIETY CONCERNING THE DEPOSITION OF THE LIBRARY OF THE FERN SOCIETY AT THE BOTANIC GARDEN

WHEREAS, the American Fern Society wishes to make the contents of its library readily accessible to all students of ferns; and

WHEREAS, the Brooklyn Botanic Garden desires to cooperate in this object; and

WHEREAS, Dr. Ralph C. Benedict, Resident Investigator at the Botanic Garden, is an officer of the Fern Society, as Editor of the *American Fern Journal*, official organ of the Society, the over copies of which are now deposited at the Brooklyn Botanic Garden in accordance with the terms of an *Agreement* between the Society and the Botanic Garden, dated January 15, 1927;

It is hereby mutually agreed as follows:

1. The American Fern Society will deposit its library, comprising books, pamphlets, and periodicals received by it in exchange for the *American Fern Journal* or otherwise, at the Brooklyn Botanic Garden, and the Botanic Garden will receive the same, and subsequent additions to the collection initially transferred, for deposit on the shelves of the Botanic Garden Library.

2. At the time of sending its library to the Botanic Garden, the Society will give the Garden, in duplicate, a full and complete list of every publication which it sends, and the Garden will sign and return one copy of this list as acknowledgment for what it receives.

3. The Society's library is to be administered as a reference library under the same regulations that govern the Botanic Garden Library as a whole, and shall be freely accessible to the Society's members, to the staff of the Botanic Garden, and to the general public, in harmony with such regulations as may be in force or adopted from time to time by the Botanic Garden authorities, concerning hours and days of opening and closing the Laboratory Building of the Garden, and access thereto and to its various rooms.

4. *a*. The publications belonging to the Society's Library will not be available for use outside the Laboratory Building except by loan to some other library, scientific institution, or school, or to the Fern Society through its officially designated representatives.

b. In general, all loans are to be for a period not to exceed two weeks, unless special arrangement for renewal is mutually agreed upon by the Botanic Garden and the borrower.

c. The borrower shall pay all costs of transportation both ways, including sufficient insurance to represent replacement value of the publication.

5. The Botanic Garden agrees to give to the books and other publications of the Society, deposited with it, similar supervision to that given to its own Library, and the Society hereby absolves the Botanic Garden from all responsibility for loss or damage to said deposited books and other publications from any cause whatsoever.

6. The books and other publications deposited are to remain the property of the American Fern Society.

7. Either party will give the other not less than one year's notice of its desire and intention to terminate and cancel this agreement.

8. The American Fern Society will remove all of the publications constituting its library and all records and papers related thereto from the Laboratory Building and property of the

Brooklyn Botanic Garden within not less than one year after notice from the Botanic Garden of its desire to terminate and cancel this agreement, and the Botanic Garden will permit the removal of said publications and records within one year of notice from the American Fern Society of its desire to remove them and cancel this agreement.

For the Brooklyn Botanic Garden:
(Signed) C. STUART GAGER,
Director.

For the American Fern Society:
(Signed) WILLIAM R. MAXON,
President.

BROOKLYN, NEW YORK,
April 21, 1930.

THE BOTANIC GARDEN AND THE CITY

THE BROOKLYN BOTANIC GARDEN, established in 1910, is a Department of the Brooklyn Institute of Arts and Sciences. It is supported in part by municipal appropriations, and in part by private funds, including income from endowment, membership dues, and special contributions. Its articulation with the City is through the Department of Parks.

The City owns the land devoted to Garden purposes, builds, lights, and heats the buildings, and keeps them in repair, and includes in its annual tax budget an appropriation for other items of maintenance. One third of the cost of the present buildings (about $300,000) and of other permanent improvements (about $253,000) has been met from private funds.

Appointments to all positions are made by the director of the Garden, with the approval of the Botanic Garden Governing Committee, and all authorized expenditures for maintenance are made in the name of the private organization, from funds advanced by the Institute, which, in turn, is reimbursed from time to time by the City, within the limits, and according to the terms of the annual Tax Budget appropriation.

All plants have been purchased with private funds since the Garden was established. In addition to this, it has been the practice of the Garden, from its beginning, to purchase all books for the library, all specimens for the herbarium, all lantern slides and photographic material, and numerous other items, and to pay certain salaries, with private funds.

The needs of the Garden for private funds for all purposes, are more than twice as great as the present income from endowment, membership dues, and special contributions. The director of the Garden will be glad to give full information as to possible uses of such funds to any who may be interested.

INFORMATION CONCERNING MEMBERSHIP

The Brooklyn Institute of Arts and Sciences is organized in three main departments: 1. The Department of Education. 2. The Museums. 3. The Botanic Garden.

Any of the following seven classes of membership may be taken out through the Botanic Garden:

1.	Annual member	$ 10
2.	Sustaining member	25
3.	Life member	500
4.	Permanent member	2,500
5.	Donor	10,000
6.	Patron	25,000
7.	Benefactor	100,000

Sustaining members are annual members with full privileges in Departments one to three. Membership in classes two to seven carries full privileges in Departments one to three.

In addition to opportunities afforded to members of the Botanic Garden for public service through coöperating in its development, and helping to further its aims to advance and diffuse a knowledge and love of plants, to help preserve our native wild flowers, and to afford additional and much needed educational advantages in Brooklyn and Greater New York, members may also enjoy the privileges indicated on the following page.

Further information concerning membership may be had by addressing The Director, Brooklyn Botanic Garden, Brooklyn, N. Y., or by personal conference by appointment. Telephone, Prospect 9–6173.

PRIVILEGES OF MEMBERSHIP

1. Free admission to the buildings and grounds at all times.
2. Cards of admission for self and friends to all exhibitions and openings preceding the admission of the general public, and to receptions.
3. Services of docent (by appointment), for self and party (of not less than six), when visiting the Garden.
4. Admission of member and his or her immediate family to all lectures, field trips, and other scientific meetings under Garden auspices, at the Garden or elsewhere.
5. Free tuition in most courses of instruction; in other courses members are allowed a liberal discount from the fee charged to non-members.
6. Invitations for self and friends to spring and fall "Flower Days."
7. Copies of Garden publications, as follows:
   - *a*. Record.
   - *b*. Guides.
   - *c*. Leaflets.
   - *d*. Contributions.
8. Frequent Announcement Cards concerning plants in flower and other exhibits.
9. Privileges of the Library and Herbarium.
10. Expert advice on the choice and care of ornamental trees, shrubs, and herbaceous plants, indoors and out, on planting the home grounds, the care of lawns, and the treatment of plants affected by insect and fungous pests.
11. Determination of botanical specimens.
12. Participation in the periodical distribution of surplus plant material and seeds, in accordance with special announcements sent to members from time to time.

FORMS OF BEQUEST TO THE BROOKLYN BOTANIC GARDEN

Form of Bequest for General Purposes

I hereby give, devise, and bequeath to The Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., the sum of.....Dollars, the income from which said sum to be used for the educational and scientific work of the Brooklyn Botanic Garden.

Form of Bequest for a Curatorship

I hereby give, devise, and bequeath to The Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., the sum of.....Dollars, as an endowment for a curatorship in the Brooklyn Botanic Garden, the income from which sum to be used each year towards the payment of the salary of a curator in said Botanic Garden, to be known as the (here may be inserted the name of the donor or other person) curatorship.

Form of Bequest for a Fellowship

I hereby give, devise, and bequeath to The Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., the sum of.....Dollars, the income from which sum to be used in the payment of a fellowship for advanced botanical investigation in the Brooklyn Botanic Garden, to be known as the .....fellowship.

Form of Bequest for other particular purposes designated by the testator

I hereby give, devise, and bequeath to The Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., the sum of.....Dollars, to be used (or the income from which to be used) for the Brooklyn Botanic Garden *

.....

.....

* The following additional purposes are suggested for which endowment is needed:

1. Botanical research.
2. Publishing the results of botanical investigations.
3. Popular botanical publication.
4. The endowment of a lectureship, or a lecture course.
5. Botanical illustrations for publications and lectures.
6. The purchase and collecting of plants.
7. The beautifying of the grounds.
8. The purchase of publications for the library.
9. Extending and enriching our work of public education.
10. The establishing of prizes to be awarded by the Brooklyn Botanic Garden for botanical research, or for superior excellence of botanical work in the High Schools of the City of New York.

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GENERAL INFORMATION

Membership.—All persons who are interested in the objects and maintenance of the Brooklyn Botanic Garden are eligible to membership. Members enjoy special privileges. Annual Membership, $10 yearly; Sustaining Membership, $25 yearly; Life Membership, $500. Full information concerning membership may be had by addressing *The Director, Brooklyn Botanic Garden, 1000 Washington Avenue, Brooklyn, N. Y.* Telephone, Prospect 9-6173.

The Botanic Garden is open free to the public daily from 8 a.m. until dusk; on Sundays and Holidays it is open at 10 a.m.

Entrances.—On Flatbush Avenue, near Empire Boulevard and near Mt. Prospect Reservoir; on Washington Avenue, south of Eastern Parkway and near Empire Boulevard; on Eastern Parkway, west of the Museum Building.

The street entrance to the Laboratory Building is at 1000 Washington Avenue, opposite Crown Street.

To Assist Members and others in studying the collections the services of a docent may be obtained. This service is free of charge to *members of the Botanic Garden;* to others there is a charge of 50 cents per person. Arrangements must be made by application to the Curator of Public Instruction at least one day in advance. No parties of less than six adults will be conducted.

To Reach the Garden take Broadway (B.M.T.) Subway to Prospect Park Station; Interborough Subway to Eastern Parkway-Brooklyn Museum Station; Flatbush Avenue trolley to Empire Boulevard; Franklin Avenue, Lorimer Street, or Tompkins Avenue trolleys to Washington Avenue; St. John's Place trolley to Sterling Place and Washington Avenue; Union Street or Vanderbilt Avenue trolleys to Prospect Park Plaza and Union Street. By Automobile from points on Long Island take Eastern Parkway west and turn left at Washington Avenue; from Manhattan, take Manhattan Bridge, follow Flatbush Avenue Extension and Flatbush Avenue to Eastern Parkway, turn left following Parkway to Washington Avenue; then turn right.

* Deceased, September 28, 1932.

BROOKLYN BOTANIC GARDEN
PUBLICATIONS

RECORD. Established, January, 1912. An administrative periodical issued quarterly (1912–1928); bimonthly beginning with 1929. Contains, among other things, the *Annual Report* of the director and heads of departments, special reports, announcements of courses of instruction, seed list, guides, miscellaneous papers, and notes concerning Garden progress and events. Free to members of the Garden. To others $1.50 a year. Circulates in 59 countries.

MEMOIRS. Established, July, 1918. Published irregularly. Circulates in 47 countries.

Volume I. *Dedication Papers:* comprising 33 scientific papers presented at the dedication of the laboratory building and plant houses, April 19–21, 1917. 521 pages. Price $3.50, plus postage.

Volume II. The vegetation of Long Island. Part I, The vegetation of Montauk: A study of grassland and forest. By Norman Taylor, June 11, 1923. 108 pages. Price $1.00, plus postage.

Volume III. Vegetation of Mount Desert Island, Maine, and its environment. By Barrington Moore and Norman Taylor, June 10, 1927. 151 pages. Price $1.60.

CONTRIBUTIONS. Established, April 1, 1911. Papers originally published in periodicals, reissued as "separates," without change of paging, and numbered consecutively. Twenty-five numbers constitute one volume. Price 25 cents each, $5.00 a volume. Circulates in 34 countries.

62. Physiologic races of Ustilago levis and U. avenae on red oats. 7 pages. 1932.

63. Inheritance of resistance to loose and covered smut in a hybrid of Early Gothland and Victor oats. 10 pages. 1932.

64. Inheritance of resistance to loose and covered smut in hybrids of Hull-less with Early Gothland and Monarch oats. 28 pages. 1932.

LEAFLETS. Established, April 10, 1913. Published weekly or biweekly during April, May, June, September, and October. The purpose of the *Leaflets* is primarily to give announcements concerning flowering and other plant activities to be seen in the Garden near the date of issue, and to give popular, elementary information about plant life for teachers and others. Free to members of the Garden. To others, fifty cents a series. Single numbers 5 cents each. Circulates in 28 countries.

GUIDES to the collections, buildings, and grounds. Price based upon cost of publication. Issued as numbers of the RECORD; see above.

Guide No. 6. Japanese potted trees (*Hachinoki*). 11 illustrations. Price, 35 cents. By mail, 40 cents.

Guide No. 7. The story of our boulders: Glacial geology of the Brooklyn Botanic Garden. 22 illustrations. Price, 35 cents. By mail, 40 cents.

Guide No. 8. The story of fossil plants. Guide to the transparencies in Conservatory House No. 2. 8 illustrations. Price, 35 cents. By mail, 40 cents.

SEED LIST. (*Delectus Seminum*) Established, December, 1914. Since 1925 issued each year in the January number of the RECORD. Circulation includes 160 botanic gardens and institutions located in 40 countries.

AMERICAN JOURNAL OF BOTANY. Established, January, 1914. Published, in coöperation with the BOTANICAL SOCIETY OF AMERICA, monthly, except during August and September. Subscription, $7.00 a year. Circulates in 53 countries.

ECOLOGY. Established, January, 1920. Published quarterly in coöperation with the ECOLOGICAL SOCIETY OF AMERICA. Subscription, $4.00 a year. Circulates in 48 countries.

GENETICS. Established, January, 1916. Bimonthly. Subscription, $6.00 a year. Circulates in 37 countries.